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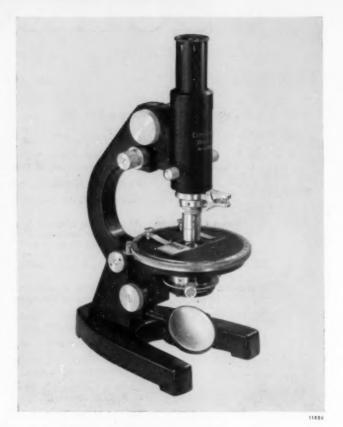


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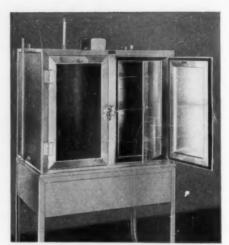
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Man and Machines

There is a hard reality behind some of the present-day lurid science fiction: Men have now made machines that are challenging the inborn anatomical and mental limitations of their masters.

Man has studied and speculated about his nature for many centuries. Probably ever since he first saw his reflection in a prehistoric pool he has wondered about himself. Throughout the ages, theologians, lawyers, physicians, philosophers, poets, myth-makers, and more recently anthropologists, psychiatrists, geneticists, physiologists, sociologists, and many other specialists, as well as psychologists, have pondered aspects of the great question "What is man?" None has yet produced the final answer. Not even the most ardent present-day advocates of the usefulness of psychology would dream of maintaining that this one area of study alone can ever give a full reply to this obdurate riddle of the Sphinx. Nevertheless, modern experimental psychology has developed useful techniques and is providing factual, fundamental information about human nature. The present-day relationship between human beings and machines and society is being made more understandable by this science in more than a few respects. When the student of mental reactions is asked, "What are the capacities of human individuals?" his answer today is far from complete, but it is possible to approach an answer in modest, factual terms.

The wise psychologist does not attempt to predict the nature of the endproducts of human artistic creation or try to determine the boundaries of man's highest intellectual potentialities or spiritual and esthetic insights. Rather, psychologists try to describe, wherever possible in quantitative terms, basic mental processes, which are often shown to be related to the anatomical and physiological living machinery of a unique primate called Homo sapiens.

In general, the information made available as a result of experimental psychology is essential to concrete thinking concerning the present-day changing relationships between man and his world. The engineer who builds a new diesel locomotive is limited by the properties of the materials he uses. The weight, strength, heat resistance, elasticity, and other characteristics of the metals he employs do not predetermine the shape into which the material is to be fabricated. On the other hand, parts of such engines cannot be made of metals that have other than very specific characteristics. The same relationship holds for one who would consider how modern machines and present-day society are related to the inborn traits of every human being. "Which of you by taking thought can add one cubit unto his stature?" also applies to other characteristics than height. A jet pilot cannot by thought, education, or wishing speed up beyond a certain fixed point the time his nerves must take in responding to external stimuli. Anyone concerned with designing new airplanes, or with training pilots to fly such planes in formations, or with developing a better political or economic system must not forget that, physiologically and psychologically, men have a large number of inborn capacities and many specific limitations .- LEONARD CARMICHAEL, Secretary, Smithsonian Institution.

This editorial is based on the Arthur Dehon Little Memorial lecture, "Psychology, the machine, and society," given at Massachusetts Institute of Technology, 17 Nov. 1953.

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Genetics of Japan, Past and Present

Taku Komai

In a review of the history of genetics in Japan, the name of Chiyomatsu Ishikawa comes first. Ishikawa was one of the few oldest graduates of the University of Tokyo who majored in zoology. He went to Germany as a postgraduate student, took his degree at the University of Freiburg, and served for some years as an assistant to Weismann. He later became professor of zoology in the College of Agriculture at the University of Tokyo and was a devoted disciple of Weismann and Weismannism until his death. The joint papers that Weismann and Ishikawa published in 1887, 1888 and 1889 (1) were concerned with the maturation and fertilization of the egg of the water flea. These papers dealt with cytological and genetical problems that might interest even some presentday investigators.

Among his pupils and associates in the College of Agriculture, Ishikawa had Toyama, who became an assistant professor under Ishikawa and taught sericultural science. Ishikawa apparently suggested that Toyama investigate the spermatogenesis and embryonic development of the silkworm. When the rediscovery of Mendelism was announced, both Ishikawa and Toyama took great interest in this new biological principle, and the latter immediately focused his studies on the heredity of various characters of the silkworm. Undoubtedly, the silkworm was one of the few animals suited for the study of Mendelism, for a number of varieties with respect to egg color, larval markings, and cocoon characters had been isolated by the older breeders. Moreover, such a study promised to contribute something to practical sericulture.

Silkworm

Toyama's first paper on silkworm genetics was published in 1906 (2). This was one of the earliest papers on Mendelism in animals, including Bateson and Punnett's on poultry, Cuénot's on mice, and Lang's on Cepaea, the land snail.

One of Toyama's early works was concerned with the inheritance of cocoon color. He crossed a race that produced a white cocoon with a race that produced a yellow cocoon and found that the colors segregated in the progeny in typical Mendelian fashion. Toyama also worked on the inheritance of larval markings, egg colors and shapes, and some physiological characters. The most important and best known of Toyama's discoveries was the maternal inheritance, which he confirmed in the inheritance of certain egg-color types in 1913 (3).

Toyama also discovered the superiority in vigor and productivity of the F₁ hybrid between certain unrelated races. He had conducted for several years a large-scale experiment on this problem under the auspices of the Governmental Sericulture Experiment Station. The results were published in 1917, and confirmed the superiority of the F₁ hybrid in respect to growth rate, vigor, and quantity of cocoon fiber. He thus recommended the breeding of such hybrids to the breeders of the whole country. This was certainly a great discovery, some-

thing like that of hybrid corn from the practical viewpoint. Recently, I was informed of a hybrid strain of silkworm called J 122 established by one Nobu Nakazato. This strain is now recognized for various reasons as one of the best (or perhaps the very best) strains, and is being reared extensively in Japan. The value of the annual increase of yield due to the use of this strain is estimated at 3000 million yen, which is equivalent to \$8.3 million.

Toyama's untimely death took place in 1918 in the midst of an active life. His investigation of silkworm genetics was handed down to several younger workers. Tanaka took the leadership of this group. He is a graduate of Sapporo University. He became assistant professor of sericultural science in the same university. He later moved to Kyushu University and taught sericulture and genetics. He has devoted himself to the study of silkworm genetics and has made important discoveries. Many men who are now engaged in the genetics and breeding of the silkworm in various parts of Japan are Tanaka's former pupils.

The silkworm culture is an age-old, great industry of Japan; raw silk and silk fabrics had been the country's most important export goods for many years. Naturally, great effort was made to promote scientific studies of the improvement of sericulture and filature. A state institute on a fairly large scale devoted entirely to this purpose was established in 1911 and is still in existence. Several prefectures run local sericulture experiment stations. Three schools of college grade trained many young men for the practice or teaching of sericulture. These colleges now form parts of local universities. Really, no other insect among the many hundred thousands of species has been studied so intensively, and no other country has ever spent so much money for such a study. It is only natural that Japan is unrivaled in this particular field of study, and this is particularly true of the genetics of this insect. The bibliography of the comprehensive Genetics of the Silkworm (4) edited by Tanaka refers to nearly 1000 papers, of which at least 80 percent were written by Japanese investigators; and the majority are papers on genetics. Another book on the genetics of the silkworm, entitled The Recent Advances in Gene Analysis of the Silkworm

The author is on the staff of the National Institute of Genetics, Misima, Japan.

(5) and written by five leading contemporary silkworm geneticists, enumerates 210 different genes that are distributed in 15 linkage groups. Thus the genetic studies of the silkworm form an important part of the contributions of Japanese investigators to the advancement of genetics in general.

If I mention the outstanding contributions made by our silkworm geneticists to genetical science in general, apart from Toyama's works that I have already mentioned, first comes Tanaka's discovery of the absence of recombination in the female, which is the heterogametic sex in moths. This phenomenon stands in contrast to the similar phenomenon known in *Drosophila*, in which recombination does not occur in the male sex. This discovery of Tanaka's in 1913 came very shortly after the discovery of the analogous phenomenon in *Drosoph*ila (6).

Next I may mention the mode of sex determination which was worked out more recently primarily by Hashimoto and Tazima (7). Sex determination in the silkworm is very different from that in *Drosophila*. It is extremely simple and clear-cut. The W chromosome is entirely responsible for this mechanism. The presence of a single W chromosome is sufficient to produce the female sex, irrespective of the number of Z chromosomes and autosomes. Thus,

Even combinations such as 3A+ZZW, 3A+ZZZW, and 4A+ZZZW have been found to be female. Tazima has endeavored to determine the exact locus of the gene or gene complex for the female sex. He obtained deletions of various parts of the W chromosome by means of x-ray irradiation and has obtained evidence that the gene or gene complex that is responsible for the mechanism of sex determination is apparently localized in a part of this chromosome. No conclusive data for the presence of a gene or a gene complex that is responsible for the male sex have been found.

The mechanism of sex determination is going to have a practical significance very shortly. In the silkworm, the male is considered to be superior to the female from a practical viewpoint. This is because the male larvae grow faster than the female larvae, the proportion of the fiber layer in the male cocoon is significantly greater than that in the female cocoon, and the fiber of the male cocoon is more uniform in its fine texture. Thus, if the sex of a silkworm can be distinguished in an early larval or egg stage,

it would be very valuable from the practical viewpoint. Tazima has obtained a strain having a piece of the second chromosome translocated to the W chromosome (8). This second chromosome piece carries the dominant gene "Sable," which gives the larva a characteristic sooty color and the egg a dark color. This character serves as the marker for the female sex. The young larvae that exhibit this color in this particular strain are invariably females. Tazima has succeeded in making this translocated piece so short that it does not interfere with the vitality of the insect. He has also succeeded in rearing a new strain in which the sex can be distinguished in the egg stage, by combining the translocated strain with another strain that is characterized by a light egg color. In this new strain, all dark-colored eggs are female, while all light-colored eggs are male. These eggs are laid in a mixture by heterozygous mother moths. The eggs are detached from the pasteboard as grains, and separated into two groups by using a machine especially devised for this purpose and utilizing a photoelectric

For a general survey of the contribution of silkworm genetics to the sericultural industry, I may quote a recent note by Yokoyama (9), who is at present director of the Government Sericulture Experiment Station. In this note Yokovama compares the figure for 1911 with that for 1951 in respect to the total yield of raw silk, on the one hand, with the total amount of the eggs used for the culture and the total area of the mulberry plantations, on the other. The yield of raw silk happened to be nearly the same in these two years, while the amount of the eggs used in 1951 was only 19 percent of the amount used in 1911, and the land area of mulberry plantation in 1951 was only 40 percent of that in 1911. These facts plainly show the extent of the improvement that has been accomplished by our geneticists in the breeding of the silkworm.

Goldfish and Oryzias

Next to the silkworm, the animals that early Japanese geneticists used as materials for their studies were goldfish and another freshwater fish, Oryzias (Aplocheilus) latipes, which we call "Medaka." Toyama did some genetic work on the goldfish but did not get any striking results. His work was succeeded by that of Higurashi (10) and further by that of Matsui (11), both of whom worked in the Fisheries Institute of the Department of Agriculture.

Oryzias has an advantage over the goldfish in its smaller size, quicker de-

velopment, and in its hardiness. This fish is commonly found in rice paddies all over Japan. Its red and white varicties are often kept with goldfish in Japanese homes. Ishihara, who was a professor of human physiology in Kyushu University, did some work on the genetics of this fish, and published a paper in 1917 (12). More extensive breeding studies of this fish were conducted by Aida in Kyoto, and his paper appeared in the 1921 issue of Genetics (13). He disclosed in this paper the presence of a gene for red body color in the Y-chromosome and its transfer by crossing over to the X-chromosome. This discovery coincided with Winge's discovery that disclosed essentially the same fact in the tropical fish Lebistes. The paper of Aida interested all geneticists, for it clearly demonstrated the presence of a gene in the Y-chromosome and also crossing over in the heterogametic sex, neither of which had been demonstrated at that time.

Influence of R. B. Goldschmidt

An event that should not pass without mention in the history of Japanese genetics was R. B. Goldschmidt's sojourn in Tokyo, Goldschmidt visited Japan first in 1914 to collect materials for his work on Lymantria. He was an old friend of Ishikawa, whom I mentioned at the beginning of this article. After Ishikawa's retirement, Goldschmidt took his chair in the Agricultural College of the University of Tokyo and stayed there from 1924 through 1926. During this period, and after his return to Berlin, several young Japanese men studied genetics and cytology with Goldschmidt, and many of them completed their doctoral theses. Goldschmidt's relationship to genetics and geneticists in Japan is still intimate in various ways, and Japanese genetics has been indebted to Goldschmidt for guidance and encouragement for a number of years.

One of the outstanding works accomplished by Goldschmidt's students was Masui's discovery of a simple method of "sexing" young chickens. I have been informed that in the United States alone there are about 2000 men engaged in this work. How much labor and expense in poultry farms all over the world are saved by sexing young chickens by this method is difficult to estimate. However, it is certain that it is enormous.

Genetics of Other Animals and Man

Drosophila was brought first by myself in 1925 from Morgan's laboratory in Columbia University to the Zoological Institute of Kyoto University. Seven or eight associates or students of mine worked on this material. Of these men, Kikkawa is probably best known, through his paper on the biochemical genetics of the eye colors of Drosophila and the eye and egg colors of the silkworm (14). He is at present in the chair of genetics of Osaka University, and he is now conducting interesting studies on the relationship of various metal elements to colors of animals and plants.

Besides these workers in the genetics of Drosophila, several other boys and girls in Kyoto University majored in genetics under me, studying materials as diverse as man, mouse, Habrobracon, Trichogramma, Harmonia (ladybeetle), Colias, Ephestia, Aphiochaeta (a dipteran), Tigriopus (a marine copepod), sea-urchins, and protozoa. It is a great pity that more than half of them died during or after the war. Japanese genetics has lost in them several promising young workers.

The study of Drosophila is also thriving under Moriwaki in the Metropolitan University in Tokyo. The genetic and cytological studies of Kawamura and his pupils in Hiroshima University with some lower vertebrate materials, such as frogs, salamanders, newts, and freshwater fishes, are also worth mentioning. They are investigating in these materials the problems of polyploidy and heteroploidy, as well as racial and subspecific differentiation.

Animal cytology in Japan has had its center in Hokkaido University in Sapporo. Oguma started this center about 1920 and directed it for about 20 years. He was succeeded by Makino, who is now focusing his own and his pupils' studies on the cytological investigation of tumors.

In the field of human genetics, Furuhata is one of the pioneers in the study of blood groups. He proposed in 1927, in regard to the inheritance of the ABO groups, a genetic theory (15) that is essentially the same as Bernstein's theory, but that was advanced independently of that author. Since then, Furuhata and his associates have continued their studies on the blood types of man, as well as of animals, and have discovered several apparently new types in human blood. These discoveries were made independently of the studies of European and American investigators. The Japanese investigators are now endeavoring to check each type of their discoveries with some types recently reported by Western investigators.

I have collected pedigrees of hereditary diseases and abnormalities from the Iapanese medical literature and compiled two monographic papers (16). As a result of this work, I have found that the Japanese people do not seem to differ much from Western people in the kind and in the mode of inheritance of such abnormalities, as well as in the incidence of the gene that controls each abnormality, but they often differ rather considerably in the incidence of genes that are responsible for normal (for example, blood types and eye colors) or subnormal (for example, dizygotic twinning, osmidrosis axillae) characters. This is only a very rough statement, but it seems to be applicable to genetic distinctions between human races in general.

Plant Cytology and Genetics

Among the pioneers of plant genetics in Japan was Ikeno, who was a professor in the College of Agriculture in Tokyo University. Ikeno is well known as the discoverer of the motile male cell (spermatozoon) of Cycas (17). The discovery of a similar spermatozoon in the Gingko by Hirase (18), which was made about the same time, was largely due to Ikeno's suggestion. Ikeno took an interest in Mendelism and conducted breeding experiments with Capsicum (red pepper), Plantago, and the rice plant (19). His book (20), written in Romanized Japanese and first published in 1913, contains a simple and clear presentation of Mendelism, something like Punnett's Mendelism that had been published 6 years previously. Also, Hoshino's studies on the genetics of the flowering time of peas and rice, published in 1915, is noteworthy, for it was one of the pioneer works in quantitative genetics (21).

Next I must mention the name of Fujii, plant geneticist and cytologist and a pupil of Strasburger. He took the first chair of genetics in Japan which was started in 1918 as one of the chairs in the Botanical Institute of Tokyo University. The majority of the present plant cytologists and geneticists we have are either Fujii's pupils or his pupils' pupils. Indeed, cytology is rather heavily represented in all branches of biology in Japan. The international organ of cytology, Cytologia, was started in 1929 under

Fujii's editorship.

The contributions of Japanese cytologists, especially to the knowledge of polyploidy in various plant groups, are widely recognized. Kihara's pioneer work on genome analysis carried out with wheat varieties is highly important both from the theoretical and practical viewpoints (22). His synthesis of the cultivated breed from the cross of an emmer wheat with Aegilops squarrosa in 1944 (23) coincided with McFadden and Sears' essentially identical demonstration by a similar experiment. Kihara's ingenious breeding method for obtaining seedless watermelons is certainly a good example of the direct application of genetic knowledge to practical plant breeding. I have been told that fairly large amounts of the "seeds of seedless watermelons" are exported from Japan to the United States every year.

The breeding of strains of rice resistant to low temperatures was accomplished by Terao and others and is an outstanding contribution of Japanese plant geneticists to agriculture, one comparable to the contribution of animal geneticists to sericulture. Imai's study on the genetics of the morning-glory (24) was among the best-known works of plant genetics that was published in the 1930's and 1940's.

I am afraid I shall be blamed for putting too much stress on animal genetics, especially silkworm genetics, and too little emphasis on plant genetics. This is because I am an animal and a human geneticist, and my knowledge of plant genetics is more limited than my knowledge of animal genetics, and also because very few of our silkworm geneticists have published their works in English or any other European language, whereas most of the plant geneticists and cytologists have written papers in English or German.

Evolution

Let me add a few words about the history of the permeation of the concept of evolution among the Japanese. This concept was first introduced to us by E. S. Morse, who was a pupil of Louis Agassiz but a devoted disciple of Darwin, Morse came to Japan in 1881 and became the first professor of zoology in Tokyo University. He gave popular lectures on Darwinism on many occasions and was heard with great interest. His work of propagating the evolutionary concept was taken up by Japanese biologists, notably by Ishikawa and by Oka. Because of the absence of religious prejudice in Japan, this concept found no obstacle in diffusing among the Japanese people.

Genetics Society of Japan

The Genetics Society of Japan was started in 1915 under the name of the Japanese Society of Breeding. It was discontinued for a few years after the publication of two numbers of its organ and was reborn in 1920 under the name of the Genetics Society of Japan. It has at present more than 1000 members. These members belong to one of the 16 branches distributed in various districts of the country. The branches hold local meetings at regular or irregular intervals. The society also holds general meetings annually at different cities where these branches are located.

Genetics Institutes

There are four chairs of genetics in Japanese state universities, one in the Faculty of Science of Tokyo University, which I have mentioned already, another in the Faculty of Agriculture in Kyoto University, still another in the Faculty of Medicine in Osaka University, and the fourth one in the Faculty of Science in Okayama University. However, genetics forms an important part of the courses of the biology departments in most of the universities in Japan. Some medical schools also have lectures on genetics, although the hours devoted to genetics are unreasonably few.

The establishment of the National Institute of Genetics in 1949, at Misima, was an important event in the history of genetics in Japan. The institute has six departments. About 30 research members studying materials ranging from man to virus are occupied in various fields of this science. Although they are working under the pressure of severe handicaps as a result of various difficulties of present-day life in Japan, they will undoubtedly produce in their studies something that will contribute to the future advancement of genetics-at least we are hoping so.

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World Symposium on Applied Solar Energy

Guy Benveniste and Merritt L. Kastens

With the purpose of fomenting and accelerating solar energy research and utilization, the Association for Applied Solar Energy, the University of Arizona, and Stanford Research Institute sponsored the first World Symposium on Applied Solar Energy and the associated Conference on Solar Energy in Tucson and Phoenix last November, More than 1000 scientists, industrialists, and interested laymen gathered to listen to 130 papers and addresses and to discuss ways to use the energy of the sun. The meetings were made particularly significant by the large attendance from abroad. From all over the world, nearly every laboratory or organization concerned

with solar energy research sent representatives to Phoenix. Thanks to the Ford and Rockefeller Foundations, UNESCO, the Office of Naval Research, the U.S. Air Force, the National Science Foundation, and the National Academy of Sciences, 130 foreign delegates from 31 different nations were able to join their American colleagues in the Valley of the

The participants were also able to observe nearly 100 working exhibits of practical developments at a special engineering exhibit located in the strong Phoenix sunshine. Exhibitors from this country and abroad participated in this special

The significance of these meetings will probably be felt as an upsurge of activity and research follows the discussions and evaluations that took place. There is little doubt that the papers discussed, and the close relationships that were established among scientists, engineers, economists, industrialists, and businessmen will advance the day when we may rely more directly on solar energy.

The papers delivered at the conference in Tucson were more technical in nature, while those presented in Phoenix were of more general interest and served as an introduction to solar energy research for the many nonspecialists who attended the meetings. The subjects of the papers at both meetings can be roughly divided into three categories: (i) solar energy measurements; (ii) increasing the world's supply of energy (mechanical, electric, and chemical); and (iii) increasing the world's supply of food (for both animal and human consumption).

Within these categories, some papers were devoted to basic research considerations, some to engineering problems related to the use of solar energy, and still others to the economic and industrial significance of the technical possibilities of solar energy.

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Solar Energy Measurements

A technical conference cosponsored by UNESCO on solar energy measurements was held in Tucson at the beginning of the symposium. This conference was under the chairmanship of S. Fritz of the U.S. Weather Bureau.

Although many radiation-measuring stations exist in many countries, it is apparent that data about insolation are not readily available for large areas. The problems considered in Tucson included the type of additional information that is most needed—the degree of measurement accuracy that is sufficient for most uses and the instruments that are required to perform these measurements correctly and simply enough to permit their widespread use throughout the world.

A. J. Drummond of the Union of South Africa reported that probably the best integrated solar measuring network in existence to date is under the sponsorship of the Weather Bureau of the Union of South Africa. However, even the delegates from South Africa were very much aware that this network is not extensive enough and that a much larger network of stations is needed. These new stations need not all make measurements with the accuracy and detail with which they are now made in most meteorological stations. But by combining the more general radiation data that would be obtained for large areas with the detailed data available in the existing stations, sufficient knowledge would be gained about the characteristics and distribution of solar radiation to allow for planning the construction of solar houses, solar engines, solar furnaces, and other applications for utilizing the sun's energy.

A total of 14 papers was presented during the radiation measurement conference. Among these, the papers of H. Stratmann of the Kohlenstoffbiologische Forschungsstation in Essen, Germany; R. Kassander of the University of Arizona; L. Morikoëfer of the Physikalisch-Meteorologisches Observatorium at Davos Platz, Switzerland; and F. Tonne of the Institut für Tageslicht Technik in Stuttgart, Germany, described radiation measurement instruments. M. Migeotte of the Université de Liège, Belgium; R. Dogniaux of the Institut Royal Meteorologique de Belgique; and A. J. Drummond also described instruments that they believed to be well suited for "mass utilization." Unfortunately, there was no agreement on the type of instruments best suited for these measurements. Of the various suggestions made, none were accepted by all those present. However, P. Courvoisier of the International Radiation Commission said after the meeting, "After all, we have not come here to solve all the problems at one time. Now we can go back, knowing what is wanted, and in due course someone will come up with the right ideas at the right time."

Increasing World Energy Supplies

How to convert solar energy into mechanical, electric, or even chemical energy-this was the main problem and one that nearly everyone at the symposium was anxious to talk about. Physicists, physical chemists, engineers, and economists attacked the problem according to their own disciplines, and the industrialists and businessmen who had joined them attempted to evaluate and correlate the various approaches. The conversion processes considered were (i) thermal conversion processes-flat-plate collectors and concentrators; (ii) electric conversion processes-photoelectric cells, photogalvanic cells, and thermocouples; and (iii) photochemical proc-

Thermal Conversion Processes

Flat-plate collectors. In the solar energy field there are two schools of thought. One is dedicated to concentrating solar energy, while the other is devoted to collecting solar energy with flatplate collectors at relatively low temperatures. The flat-plate collectors make use of the hothouse effect, absorbing the radiation on a dark surface and inhibiting reradiation loss by appropriate insulation and usually one or more parts of glass cover plates. These flat-plate collectors have been studied for several years, particularly by H. C. Hottel at Massachusetts Institute of Technology (1). Their characteristics are well known and they are efficient as long as the output temperatures needed are low. Flat-plate collectors used to heat water to a temperature of about 50° to 70°C may well operate with an average efficiency of 50 percent; they are very inefficient at temperatures above 100°C.

Up until the present, most flat-plate collectors have been used in hot-water installations, space-heating installations, and in mechanical pumps.

Solar water heaters using flat-plate collectors have been in use in the southern part of the United States for many years. Their usefulness has therefore already been described in the literature (2).

H. Heywood of the Imperial College of Science and Technology, London; I. Tanashita of Keio University, Tokyo; and L. F. Yissar of Holon, Israel, described installations that have been built in their countries. These installations consist usually of a flat-plate collector area (from 30 to 60 square feet, depending on climate and consumption) connected to an insulated storage tank (50 to 100 gallons) that is located about 2 feet above the collector to permit thermosiphon flow of the heated water. These installations were described as economical and efficient.

J. Hobson of Stanford Research Institute indicated in a paper concerned with the economics of solar energy that, as a rule of thumb, solar water heaters are economical wherever competing fuels cost more than \$1 per million British thermal units—assuming, of course, that there is enough sunshine. He believes that a vast rural market exists for such heaters and that solar water heaters could be manufactured in the United States in large quantities for this potential market.

Space heating and space cooling were considered in several papers. R. W. Bliss, Jr., of Amado, Ariz.; M. Telkes of New York University; G. O. G. Löf of Denver, Colo.; and H. C. Hottel of Massachusetts Institute of Technology described their experiences with the solar houses they have built in the past and the improvements they would now propose. A paper describing a system using solar-energy collectors in conjunction with a heat pump installation was described by P. Sporn and E. R. Ambrose of American Gas and Electric Service Corporation. Various other papers were presented and were followed by a discussion of the architectural problems of solar collectors.

The papers indicated that solar collectors with auxiliary conventional heat sources can supply all space-heating requirements of dwellings with adequate roof area in regions with average or better-than-average climates. The installations that have been built in the United States have been comparatively expensive, and the cost of producing solar British thermal units for space heating has competed with difficulty with the cost of conventional heat sources. To date, most of the solar installations built in the United States have been built in or near cities, where fossil fuels are relatively inexpensive. The solar houses built in Denver, Colo., (3), Cambridge, Mass., (4), and Dover, Mass., (5), were all located near adequate fuel markets. The only exception, the Bliss solar installation built in the southern Arizona desert, still has to compete with installations using bottled gas, which is fairly inexpensive in that part of the United States. The Bliss house, using an outdoor, hot-air solar collector and rock bin for storage, can be both heated and partially cooled by means of its solar-collector installation. The cooling cycle consists essentially of storing the coolness of the night desert air in the "rock-bin" storage system; the cool air is used during the day by circulating house air through the rock pile. The installation is reported to have cost \$4,000 (6), which is quite an investment for a small space-heating-and-semicooling plant, even in this country, where we are willing to pay more than other peoples to be comfortable during cold and hot spells.

Still, there should be little doubt that space heating, and ultimately, space cooling will become important uses of solar energy. It is inevitable that in all areas of the world where fuels are relatively expensive and where some sunshine and roof space are available, man will sooner or later turn to the sun to heat his home.

Further research in finding ways of integrating solar collectors into the design of homes and of reducing heat losses and costs is bound to make this application of the sun's energy an economical possibility. This research effort is important since space heating and cooling energy requirements represent about 30 percent of all the energy that is consumed in the

United States today.

Another interesting use of flat-plate collectors is in mechanical pumps. Using the sun to generate power has been the dream of men for many years. During the last century, many American engineers devoted much time and effort to developing solar pumps. The attempts of Ericson (1888), Boys (1900), and Shuman (1906) are well known today (7). Their efforts usually failed because the equipment developed was bulky and expensive and because, at that time, the competing fuel-coal-was becoming less and less expensive as mining techniques were improved constantly.

The hundreds of Arizona farmers who visited the solar exhibit in Phoenix observed a simple Italian solar pump in action. Such was their interest that it has been conservatively estimated that 50 of these pumps, manufactured by the Somor Company in Lecco, Italy, could have been sold on the spot if they had

been available.

This pump utilizes an ordinary flatplate collector to vaporize sulfur dioxide which drives a simple, one-cylinder motor that is cooled by the pumped water. The pump converts solar energy into mechanical energy at about 4-percent

In his paper on the "Economics of solar energy," J. Hobson estimated the cost of this power to be, in optimum circumstances, between 5 and 10 cents per kilowatt hour. This figure reflects the high initial price of these devices and the low load factor under which they must operate with intermittent solar energy. However, 10 cents per kilowatt hour is not expensive power where other fuels are not available and where man must depend on animal power or even his own power for his daily bread.

Some recent developments with selective surfaces indicate that it may be possible to reduce the cost of flat-plate collectors appreciably in the near future. Probably of greatest interest in this respect was a paper presented by H. Tabor of the Research Council of Israel. He reported on the possible use of selective surfaces to obtain substantially higher temperatures than are possible with ordinary flat-plate collectors.

A selective surface can be defined as a good absorber of sunlight and a poor emitter of thermal radiations. Sunlight comes mostly in short wavelengths of 300 to 2000 millimicrons. On the other hand (from Wien's displacement law), the thermal radiation emitted by a body heated to 300° to 400°C has wavelengths mostly above 2000 millimicrons. A selective surface is therefore absorptive to short-wavelength radiations and reflective to long-wavelength radiations. It absorbs sunlight readily and emits

Naturally, most good conductors with a low emissivity coefficient will also be highly reflective. Tabor gave the example of a highly polished aluminum plate that may have an emissivity of 0.039 at 400°F but is at the same time a poor absorber of sunlight. The approach Tabor took was to deposit a very thin film on the bright metal base to make the surface appear black in the visible spectrum. These deposits can be made with metallic smoke films like the gold smoke filters that were produced by Harris and others at Massachusetts Institute of Technology (8) or by other techniques such as electrolytic plating and chemical or electrochemical surface treatment. Tabor experimented with blackening of copper and silver by sulfides, stopping the process when a very thin layer had been produced. He obtained an apparently black surface with a low emissivity. He also obtained such selective surfaces by depositing a very thin black nickel layer on various metals. In this way, he obtained a collecting surface, nearly black to the visible spectrum and therefore a good absorber of sunlight, but still highly reflective to long-wavelength radiation and a poor emitter of heat.

Even with such selective surfaces, the solar collector still requires a glass cover to reduce convection heat losses. Tabor believes a collector-motor device using a surface with an emissivity E = 0.1 and with the space between the metal and the glass partially evacuated could yield a yearly over-all theoretical Carnot efficiency of 14 percent and an average temperature of 172°C. If no vacuum is used, the estimated over-all efficiency is about 8 percent. It is therefore probable that solar pumps using such surfaces could operate at average efficiencies of about 10 percent, 3 times as high as presently. Such an increase in efficiency without a corresponding increase in the cost of the collectors could mean a very substantial cost reduction. A pilot plant was built in Israel, and further experimental tests will be carried on in the near future.

Concentrators. To a "flat-plate collector man," all attempts to concentrate solar energy are hopelessly expensive and difficult, since moving mirrors and structures are required. To a "concentrator man," all attempts to use flat-plate collectors are a waste of time, since the collectors are clumsy, large areas are required, and no high temperatures are attainable. However, the meetings in Tucson and Phoenix indicated that concentrators also can certainly be used successfully. They have been used in many different ways. Small parabolic reflectors with an area of about 1 square meter have been shaped into solar cookers; large accurate parabolic reflectors are used as solar furnaces; cylindroparabolic collectors have been used in steam-boiler installations, and, finally, arrays of flat mirrors aimed at a single target can be used for many purposes.

Depending on the concentration ratio, temperatures can be reached all the way from ambient temperature to 3500°C. If reasonable efficiencies are desired, it can be shown that flat-plate collectors are best used for temperatures up to 70° or 80°C, selective-surface collectors up to 175°C, and concentrators from 100°C to 3500°C. The main disadvantage of concentrators is that the collector or an auxiliary mirror must track the sun, and the mechanism that is required to do this

is usually expensive.

The papers presented by J. A. Duffie of the University of Wisconsin; M. L. Ghai of General Electric Company; and M. Telkes of New York University described various models of solar cookers. J. Hobson indicated in his paper that there is little doubt that solar cookers are economical. There is no doubt, too, that those developed to date (9) -mostly outdoor solar cookers where food is cooked at the focus of a small parabolic reflector-are not yet liked and accepted by the people for whom they are intended and that they are not an acceptable substitute for the age-old custom of cooking with charcoal or wood or even cattle dung, as in India or Egypt. The solar cooker cannot after all replace the conventional brazier completely, at least not at night or on rainy days. Also, and more important, these cookers now sell for about \$15 (10) and there are few poor people, especially in India and in Egypt, who can afford them.

New research efforts must be directed

toward designing a more practical and economical solar cooker before any vast number of the poor populations of the earth agree to change their customary cooking methods. Meanwhile various American manufacturers are examining the possibility of marketing cookers for the large barbecue and picnic market in this country.

Much interest was shown in solar furnaces at the symposium. F. Trombe of the French National Center for Scientific Research, reported on the work at the Mont Louis Laboratory in the Pyrenees, where a 35-foot furnace—the largest in the world—has been in operation for several years. There is no doubt that the solar furnace is a well-established high-temperature research tool that permits operation free from contamination by flames, magnetic fields, and the like, at temperatures as high as 3000° to 3500°C.

Some of the participants expressed the belief that the solar furnace is also a potentially useful industrial tool. To introduce French industry to the possibilities of this tool, G. Dupouy, director of the French National Center for Scientific Research, announced that construction was beginning on a 1000-kilowatt furnace (10 times larger than the one at Mont Louis) to be located in the Pyrenees not far from existing installations. This furnace will be used for the production of ceramic and metallurgical materials.

The most interesting report on steam generation was prepared by V. A. Baum of the heliotechnical laboratory of the U.S.S.R. Academy of Science. Some years ago the Soviets built a large (80 square meters) parabolic concentrator to generate steam, which was used in a refrigeration cycle. Although this installation was bulky and expensive, it was the first time solar energy was used for the production of ice. Baum reported that he could produce 250 kilograms of ice per day with this unit.

In his paper, Baum described the plans for a centralized 1000-kilowatt solar power plant now on the drafting boards of his laboratory. This plant will be able to generate steam at 350°C and 16 atmospheres pressure. It would consist of a central black-body boiler on a 40-meter tower at the focus of 23 concentric railroad tracks on which railroad cars with flat mirrors would focus the sun's rays to the unique target. The mirrors would follow the apparent path of the sun by traveling during the day around the track. The target would also rotate slowly during the day to follow the sun. This plant would then produce steam for electric-power generation and use low-pressure steam to heat homes in winter and to cool them in the summer with a refrigeration unit.

Some interesting work with concentrators has also been done in India by K. N. Mathur and K. L. Khanna at the National Physical Laboratory of India and by A. L. Gardner of the Indian National Scientific Documentation Centre. Their interest has been mostly hotair engines (11), and Gardner has developed very simple and very cheap concentrators consisting of arrays of flat mirrors aimed at a single target.

One cannot leave this particular subject without mentioning the pioneering work in this country of Charles Abbott of the Smithsonian Institution, who has built (12), and is still building, small solar engines with specially designed flash boilers to permit rapid steam generation under exposure to sunshine.

Electric Conversion Processes

Photovoltaic cells. Much attention was devoted at the symposium to recent developments with voltaic cells for converting sunlight directly into electric energy. Nine papers were devoted to this subject. G. L. Pearson and M. B. Prince of Bell Telephone Laboratories reported some of their work with silicon cells that has received considerable attention in the press and technical literature (13). The converter developed by Bell Laboratories consists essentially of a silicon crystal with a small amount of arsenic impurity covered with a very thin layer of boron impurities (about 10-4 inch deep). The crystal so prepared is about 1 inch in diameter and 0.04 inch thick. A number of such small crystals or wafers may be connected in series and assembled on a common backing; they convert solar energy into electricity at convenient direct-current voltages. These cells are now being tested in operating telephone repeaters near Americus, Ga.

The papers presented at Tucson and Phoenix did not add much to what has already been said on the subject. Silicon cell batteries have reached, in the laboratory, conversion efficiencies of 11 percent, and the theoretical maximum efficiency that could be reached is about double that figure. It was suggested by E. D. Jackson of Texas Instruments, Inc., that by placing spectrally selected semiconductor cells one on top of the other in stacks, higher efficiencies could be obtained per unit area. Jackson calculates that three such selected wafers could possibly boost the total spectral absorption from 45 to 69 percent, while a stack of ten such units would increase this possibly to 86 percent, at the same time increasing the cost of the collecting area at least tenfold. With land costs at their present level, it is doubtful that such arrangements could have much economic significance except perhaps in spaceship power-supply installations.

No final economic evaluation of these cells is possible at this early stage, but W. R. Cherry of the Signal Corps Engineering Laboratory indicated that present cost of 1 kilowatt hour obtained from a photovoltaic cell may be around \$140 while 1 kilowatt hour obtained from flashlight cells may cost only \$23.70. At such prices, he indicated, applications are bound to be limited. On the other hand, D. Wolfe of the Radio Corporation of America suggested at the final session in Phoenix that in the future mass production techniques may well bring these prototype costs down 100- or even 1000-fold.

Discussion of other photovoltaic materials included reports by D. C. Reynolds of Wright Air Development Center on experience with cadmium sulfide cells. Reynolds and his coworkers have been able to obtain an over-all conversion efficiency of about 1 percent. Another paper by J. Loferski of the Radio Corporation of America indicated that cadmium telluride, gallium arsenide, and indium phosphide would be the most efficient materials for photovoltaic converters. However, the gain in efficiency of these materials over silicon is not very large, while costs might be even higher.

Thermocouples. One session in Tucson was also devoted to thermocouples and to thermoelectric generators. T. Momota of the Electrotechnical Laboratory, Tokyo, reported experiments with reduced titanium dioxide semiconductors in which efficiencies slightly in excess of 1 percent at 550°K were obtained. From his results, he predicted that lead telluride might permit efficiencies as high as 16 percent. M. Telkes of New York University suggested the possible use of a zinc antimony alloy system with efficiencies above 3 percent.

Further research in this field may ultimately yield a much cheaper collecting surface with, perhaps, lower efficiencies than the silicon converter mentioned previously. The thermocouple material is relatively inexpensive, and the collector—even with a glass cover—may cost much less than silicon or other photovoltaic materials. It is still questionable whether such thermocouples can give useful efficiencies and thus make it possible to realize the advantage of their lower installation cost. Further research may give us answers to these questions.

Photogalvanic cells. One paper by K. M. Sancier of Stanford Research Institute described the various types of photogalvanic cells that have been known for years. His experience with certain of these cells indicated a conversion efficiency not far different from those attainable with thermocouples. He de-

scribed a prototype cyclic photogalvanic cell with a counter half cell consisting of a graphite-oxygen electrode and the photogalvanic half cell—a copper-copper oxide cell that developed an efficiency of 0.1 percent. These cells might be used as a continuous power source without the consumption of electrode material or electrolyte. This paper indicated that further research in this field may prove profitable.

Photochemical Conversion Processes

Probably one of the most promising attempts at converting solar energy to power is through the production of hydrogen by the photochemical breakdown of water under exposure to sunlight. Various organic and inorganic photocatlysts that will absorb sunlight and transmit the absorbed energy to a second reactant that will initiate the decomposition of water are used in most reactions. In the decomposition reaction, the photocatalyst and all other reagents are regenerated so that only water is consumed. It is still too early to know whether such experiments will be completely successful; but if they are, fairly high maximum efficiencies of the order of 30 to 40 percent could be expected.

The obvious advantages of obtaining hydrogen in such a reaction are (i) the collecting surface could be relatively simple, requiring no insulation; (ii) hydrogen can be stored easily and cheaply; (iii) hydrogen may be converted into electric energy at very high efficiency in hydrogen-oxygen fuel cells such as those now being developed in England.

L. J. Heidt of Massachusetts Institute of Technology has been working for several years with reactions that use ultraviolet light and solutions that contain ceric perchlorate and perchloric acid. The maximum theoretical efficiency of this reaction is low since only a small portion of the sun's spectrum can be used. Until now, only small quantities of hydrogen have been obtained. R. J. Marcus of Stanford Research Institute (14) has been experimenting with slightly more complex photochemical reactions to obtain hydrogen and oxygen from water.

Increasing the World's Food Supply

Solar energy has been used for a long time to supply man with food. Unfortunately, the present food supply is not sufficient to feed all the inhabitants of the world with an adequate diet, and science is being called upon to explore new and more efficient techniques of food production.

The interest of the biologists and engi-

neers at Tucson and Phoenix was concentrated on the problems of (i) increasing the world supply of fresh water with solar stills to convert saline or brackish waters into fresh water for domestic or agricultural uses, (ii) finding more efficient plant cultures to increase the world supply of food directly, and (iii) increasing the rate of growth of certain crops by using reflectors or other auxiliary heat collectors.

Solar stills. The interest in converting saline water into fresh water has been spearheaded in this country by the saline conversion program of the Department of the Interior. The seven papers on solar water conversion described much of the research that has been carried on under this program.

The solar stills developed to date, although they are adequate to supply small quantities of water for human and possibly animal consumption, are still too expensive for use in large-scale irrigation projects. New developments in the field were reported by American and Algerian researchers. Tilted stills have been developed by M. Telkes of New York University and by J. Savornin of the Université d'Alger. Plastic stills developed by J. Bjorksten and P. Lappala of Bjorksten Research Laboratory show promise of reducing costs further. The papers and the results presented indicate that although solar stills cannot produce fresh water at prices acceptable to large-scale consumers such as farms and large cities, there is no doubt that small stills can provide drinking water at reasonable prices in many areas of the world where there is none available. For example, there is considerable interest now in Australiawhere sheep are raised and where fresh water is rare-in using stills to obtain fresh water from brackish waters.

Efficient plant cultures. One of the most efficient plant cultures that has received considerable study in recent years is an algae called Chlorella. Many papers were therefore devoted to its characteristics. While no one exactly agrees on the energy conversion efficiency of Chlorella, it appears that under favorable conditions, Chlorella will do better than most higher plants. Chlorella therefore may provide a technique for increasing the world's food supply and possibly even for producing fuels for use in conventional boilers. Unfortunately, to date no strain of Chlorella has been found that will grow profusely without somewhat complicated and costly equipment.

The results reported at the symposium by H. Tamiya of the Tokugawa Institute for Biological Research, Toyko, clearly indicate that the present estimated cost of growing Chlorella under the most favorable conditions is high. Chlorella proteins still seem to cost twice as much, roughly speaking, as proteins obtained

from other sources. Tamiya estimated that Chlorella grown in a large 100-acre plant in Japan would cost 25.8 cents per pound. He estimated that in the United States these costs would be about 33.6 cents per pound. Taking into account the protein content of Chlorella, this means that Chlorella protein would cost about 57.3 cents per pound in Japan and probably retail at about 76 cents per pound. These prices are higher than the cost of proteins obtained from soybeans, mackerel, sardines, or whale meat in Japan, but considerably less than the cost of proteins from eggs, milk, pork, or beef. Indeed, Tamiya is hopeful that Chlorella can be used with other conventional foods to increase the protein consumption in his country.

There are other ways of growing Chlorella that show economic promise for future use. H. B. Gotaas of the University of California reported on experiments conducted in his laboratories on growing Chlorella in conjunction with waste disposal and sewage processing. His experiments show that very valuable food—perhaps cattle feed—may be grown on sewage at no appreciable additional cost over that of conventional sewage-treatment practices.

Of interest also from a nutritional point of view was a report by H. Fink of the University of Cologne, Germany, on an experiment in feeding rats a Chlorella protein diet. The experiment was reported a success. The rats not only liked Chlorella, but apparently showed a lesser tendency to suffer from liver necrosis, and they did just as well with Chlorella proteins as they did with more usual protein diets.

Mary Belle Allen of the University of California described photosynthetic nitrogen fixation with certain blue green algaes. She reported that it has been possible to grow rice with no nitrogen other than that fixed from the air by algae growing together with rice plants. In such a way it would be possible to maintain the fertility of rice fields at little additional cost.

Papers by N. W. Pirie of Rothamsted Experimental Station, Harpenden, England, and P. C. Mangelsdorf of Harvard University stressed the merits of higher plants as storers of solar energy. Their contention was that if as much time, attention, and care were devoted to certain higher plants as have been devoted to Chlorella, there is little doubt that increased growth efficiencies close to those demonstrated by some Chlorella strains would be obtained. Mangelsdorf pointed out that of approximately one-third million species of plants in the world, the world's people obtain the larger proportion of their food from approximately 12 species (potatoes, sweet potatoes, cassavas, cane, beets, rice, wheat, corn, soy-

beans, common beans, coconuts, and banana). The various types of plants mentioned (root plants, sugar plants, grains, beans, and trees) appeared to him as a promising field for the study of hybridization.

It is probable that in the years to come the emphasis of research will be directed toward attempts at modifying the genetics of higher plants to increase, among other things, their protein productivity.

Although no papers dwelt on the subject of agricultural aids, two exhibits at the engineering show illustrated the possible use of inexpensive collectors to increase ground heat and reduce frost damage.

Conclusions

As our fossil fuel resources dwindle, new energy sources will have to be found to satisfy man's requirements. Solar energy will play an increasingly important role in this reorientation together with such resources as fission and, possibly, fusion energy. Solar energy will also be put to more efficient use in supplementing the available world food supply.

Solar energy will best be used where the density of energy demand is low. It is doubtful that large energy consumers -aluminum plants and large manufacturing concerns-will ever rely much on solar energy. It is also doubtful that solar energy will be used significantly in crowded cities. On the other hand, it

is apparent that many uses will be found for it in suburbs, in rural areas, and in isolated locations.

The symposium emphasized that scientists, engineers, and industrialists may now get together and profit from their knowledge. Much capital, much research, and much effort will be needed before solar energy can be used in the world by processes other than those nature has been using for a long time, but there is little doubt that this nearly inexhaustible supply will be put to use to improve man's standard of living.

Research is badly needed to solve many problems connected with solar energy. But more than isolated research is needed-more than that which has been done in the past. A concerted effort is required by all those concerned with these problems and by all those who realize the importance of finding new energy supplies to supplement our dwindling resources.

As a communication device, the solar symposium must be counted a success. Personal contact was established among investigators from all geographic and scientific origins. Thoughts and experiences were exchanged informally and in detail that is impossible in impersonal scientific publication.

Perhaps even more important, the status of solar technology was brought to the attention of men of government and industry who must ultimately realize any practical use of this energy source.

It may be hoped that this improved

interchange of information and mutual stimulation will increase both the intensity of research effort and the rate of progress in solar engineering. If this further objective is achieved, this meeting will have advanced the day when man will be able to depend more and more on the sun for his supply of energy.

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Elmer Drew Merrill, Administrator and Botanist

There are few prominent scientists of the present era who are so nearly selftaught in the field of their prominence as was Elmer Drew Merrill, whose total formal training in botany included but two one-semester courses taken as an undergraduate at Maine State College of Agriculture and Mechanic Arts (now the University of Maine). Offsetting this lack of formal training to some extent was an early interest in natural history that began even prior to his high-school days in Auburn, Maine, where he was born 15 October 1876. In Merrill's first real job,

he was fortunate to be associated in a quasi-apprenticeship capacity with the agrostologist F. Lamson Scribner in the U.S. Department of Agriculture, for it was there that he gained a needed broader experience and training in systematic botany.

In 1902, Merrill went to the Philippines, where he progressed gradually to become director of the Philippine Bureau of Science, a position he left to become dean of the College of Agriculture and director of the Agricultural Experiment Station at the University of California.

Six years later, he moved to the directorship of the New York Botanical Garden, and finally, in 1935, he became Arnold professor of botany, director of the Arnold Arboretum, and administrator of botanical collections at Harvard University, where he served until his retirement in 1946 at the age of 70. He then became Arnold professor of botany, emeritus.

Between 1919 and 1946, Merrill occupied administrative positions that would have effectively eliminated the possibilities of scientific research for most men. However, he was not only able to cope with administrative duties during much of his active career, but he also managed to carry on a sizable research program as well and produced more than 500 original scientific papers. His contributions to botany were in floristics, plant geography, plant nomenclature, and botanical bibliography and history. In his most recent book, The Botany of Cook's Voyages, published in 1954, he dealt critically with various ideas and theories relating to the area of origin of economically important plants and their dissemination during

historical time. Several earlier titles make clear Merrill's prior concern with evidence from botany as it bears on the prehistory and movements of peoples and cultures of the Pacific region and of the Western Hemisphere. For example, in 1920 he wrote on ". . . Cook's theory as to the American origin and prehistoric Polynesian distribution of certain economic plants . . ." Later titles, such as "The phytogeography of cultivated plants in relation to the assumed pre-Columbian Eurasian-American contacts" and "Domesticated plants in relation to the diffusion of culture," show some of his predilections.

By the time Merrill left the Philippines in 1919, he had a surprisingly comprehensive knowledge of the plants of the whole Polynesian area, and this remained his chief area of floristic interest. Putting this knowledge to practical use during the last war, he produced a manual describing emergency food plants and poisonous plants of the Pacific islands and a book, Plant Life of the Pacific World, that were published for and widely used by the Armed Forces. His major contributions to botanical science arose from this wide acquaintance with the plants of a relatively complicated flora that was scarcely known except to a very few contemporary botanists.

Each institution with which Merrill became associated was rapidly enriched with new collections due to his stimulation. The flow of materials sometimes became a flood, and, in an instance or two, threatened to submerge all available space where he was located. In his research, he seldom went far below the surface, being content in most instances with identifying the plants with which he dealt. In this respect, he was one of a small group of floristic taxonomists of which there are but few remaining. This

type of taxonomic research was suitable to the region of his study and was the only approach that would have permitted him to cover the ground that he did in his lifetime.

Merrill moved in national and international botanical circles and in numerous scientific societies. He was frequently consulted on botanical and other scientific matters and received recognition and numerous honors for his position and leadership in the botanical field. He served as president of the Botanical Society of America, the American Society of Plant Taxonomists, and was a member of the National Academy of Sciences and a number of other organizations.

Merrill died in Boston, Mass., 24 February 1956, after long, incapacitating illness

Reed C. Rollins Gray Herbarium, Harvard University, Cambridge, Massachusetts

Gustav Egloff, Petroleum Scientist

A catalyst is a substance that accelerates a chemical reaction without itself being used up in the process. This definition is a little too simple, because all catalysts, no matter how good, wear out after a time and have to be regenerated or replaced. On 29 April 1955, the petroleum industry lost a dynamic human catalyst, Gustav Egloff. Unfortunately, it will not be possible to replace this catalyst among scientists.

Dr. Egloff was the product of the industrial era in which he lived as well as his own driving energy. His insatiable curiosity and enthusiasm kept him at work continuously. A clear thinker, Dr. Egloff had little patience with anyone who lacked this attribute. A meeting with "Gus," whether at breakfast, at a cocktail party, or at a scientific meeting, always meant pleasant conversation, interspersed with some searching questions. He always wanted to know what was going on in industry, why it was being done, and what his company could do along that line.

Dr. Egloff's primary interests were in applied science, His wide knowledge of industrial procedures and industrial needs made it possible for him to see practical applications for new scientific discoveries. The Universal Oil Products Company filed and obtained many patents based on Dr. Egloff's ideas.

Although Dr. Egloff's primary interests were in applied science, he was also sincerely interested in fundamentals. This concern led him to build an efficient library staff that aided him in the preparation of a series of books on the physical properties and reactions of hydrocarbons. In this work the most notable of his assistants was Miss Mary Alexander. For several years, she served as chairman of the nomenclature committee of the division of organic chemistry of the American Chemical Society. We owe Dr. Egloff a debt of gratitude for having contributed his own time and that of his library staff in preparing these valuable contributions to the literature. Dr. Egloff was very proud of the success of his assistants and associates.

Because of his work on the physical properties of hydrocarbons, he was selected as one of the four members of the advisory committee for the American Petroleum Institute research project 44, on

the "collection, selection, calculation, and tabulation of the physical properties of hydrocarbons." This project was initiated in 1942. His advice and counsel in the meetings of this advisory committee were of great value in getting this important project started. Not the least of his contributions were the good stories with which he occasionally enlivened these long and sometimes tedious meetings. Dr. Egloff also served as chairman of the division of petroleum chemistry of the American Chemical Society (1947-48) and president of the American Institute of Chemists (1942-46). At the time of his death, he was an active member of the committee to administer the petroleum research fund of the American Chemical Society.

Of Dr. Egloff's personal life his friends in industry knew little. He resided with his wife in Chicago and enjoyed walking to his office on Michigan Avenue, summer and winter. That brisk morning walk was seldom missed. As a young man he liked long-distance bicycle riding, and, while he was a student at Columbia, he enjoyed wrestling. He helped many worthy young men who were struggling to complete their education, but one learned of these acts of kindness only from others, never from "Gus."

Dr. Egloff attended and addressed scientific meetings in this country and abroad. At future scientific meetings all of us who knew Gustav Egloff will miss his smile, friendly greeting, and searching mind.

STEWART S. KURTZ, JR.
Research and Development Department,
Sun Oil Company,
Marcus Hook, Pennsylvania

News of Science

AAAS Editor

The AAAS is very pleased to announce that Graham DuShane will continue on a permanent basis as editor of Science and The Scientific Monthly. Since 1 Jan. DuShane has served as editor, while on leave of absence from his position as professor of biology at Stanford University. He has submitted his resignation to Stanford in order to accept the editorship.—D. W.

National Academy Elections

The National Academy of Sciences at its 93rd annual meeting in Washington, D.C., elected a treasurer, two members of the council of the academy, 30 members, and four foreign associates. William J. Robbins, director of the New York Botanical Garden, New York, was reelected treasurer for a 4-year term, beginning 1 July. In addition to Robbins, present officers of the academy, all of whom are members of the council, are as follows: president, Detlev W. Bronk; vice president, George W. Corner; home secretary, Hugh L. Dryden; and foreign secretary, John G. Kirkwood.

I. I. Rabi, professor of physics at Columbia University, and F. E. Terman, provost and dean of the School of Engineering at Stanford University, were elected to the academy council to succeed James Gilluly and Edwin B. Wilson. Other members of the council are Farrington Daniels, E. A. Doisy, Theophilus S. Painter, and Merle A. Tuve.

New members of the academy are Georg von Békésy, senior research fellow in psychophysics, Harvard University; Manson Benedict, professor of nuclear engineering, Massachusetts Institute of Technology; Konrad E. Bloch, professor of chemistry, Harvard University; Kenneth S. Cole, director, laboratory of biophysics, National Institute of Neurological Diseases and Blindness, Bethesda, Md.; Bryce L. Crawford, Jr., professor of physical chemistry, University of Minnesota; William A. Fowler, professor of physics, California Institute of Technology; Caryl P. Haskins, president, Carnegie Institution of Washington, Washington, D.C.; Emil W. Haury, professor

of anthropology, University of Arizona; Polykarp Kusch, professor of physics, Columbia University; Albert L. Lehninger, professor of physiological chemistry, Johns Hopkins University; Maria G. Mayer, senior physicist, Argonne National Laboratory, Lemont, Ill.; Charles P. Miller, professor of medicine, University of Chicago; William W. Morgan, professor of astronomy, Yerkes Observatory, University of Chicago, Williams Bay, Wis.; Walter H. Munk, professor of geophysics, Scripps Institution of Oceanography, La Jolla, Calif.; and

Melvin S. Newman, professor of chemistry, Ohio State University; Robert F. Pitts, professor of physiology, Cornell University; John D. Roberts, professor of organic chemistry, California Institute of Technology; Karl Patterson Schmidt, emeritus curator, department of zoology, Chicago Natural History Museum, Chicago, Ill.; Martin Schwarzschild, professor of astronomy, Princeton University; Claude E. Shannon, research mathematician, Bell Telephone Laboratories, Inc., Murray Hill, N.J.; Folke K. Skogg, professor of botany, University of Wisconsin; Norman E. Steenrod, professor of mathematics, Princeton University; Walter H. Stockmayer, professor of physical chemistry, Massachusetts Institute of Technology; Albert Szent-Györgyi, director of research, Institute for Muscle Research, Inc., Marine Biological Laboratory, Woods Hole, Mass.; Charles H. Townes, professor of physics, Columbia University; Francis J. Turner, professor of geology, University of California, Berkeley; Jean Verhoogen, professor of geology, University of California, Berkeley; Maurice B. Visscher, professor of physiology, University of Minnesota; John C. Warner, president, Carnegie Institute of Technology, Pittsburgh, Pa.; Walter H. Zinn, director, Argonne National Laboratory, Lemont,

New foreign associates are Frederick G. Gregory, director, Research Institute of Plant Physiology, and professor of plant physiology, Imperial College of Science and Technology, London, England; Kariamanikkam Krishnan, director, National Physical Laboratory, New Delhi, India; Albert E. Michotte, professor of psychology, University of Lou-

vain, Louvain, Belgium; Joseph Jean Camille Pérès, dean, Faculty of Sciences, and professor of rational mechanics, University of Paris, Paris, France.

Soviet Nuclear Explosion

Seitaro Koyama of Niigata University in Japan recently told a research panel of the Japan Meteorological Society that the Soviet nuclear explosion in March may have used thorium-232 as the principal element. Tests of radioactive rain that fell in the Niigata area on Japan's west coast on 21 Mar. and 24 Mar. produced results different from those made following previous thermonuclear blasts.

In other tests following reports of thermonuclear blasts, neptunium-239 and uranium-237 were abundant in rainwater, but this time these elements were absent. Also, for the first time the contaminated rain yielded an equal or greater amount of strontium as compared with barium; in the past, strontium has been one-third to one-tenth of the barium content. Koyama reported that, in addition, he had found rubidium-86 in quantities up to 2 percent. This element had not been detected in previous tests.

Humanities for Engineers

After a 3-year survey, the American Society for Engineering Education has reaffirmed the importance of studies in the humanities and social sciences in the training of professional engineers. A special committee of engineering and social studies teachers in American engineering schools, as well as a number of industrial representatives, say in their report that

"The humanities and social sciences are, in a deeply serious sense, practical and useful. To meet his growing responsibilities and to realize his capacities as a human being, the engineer needs both professional competence and a broad understanding of himself and of the world in which he lives. He needs depth, flexibility, and a capacity for growth in directions which we ourselves can today only dimly visualize. Like other professional men, he does not graduate from college with a completed education.

"Given this view of the engineer as a professional man and as a human being, the humanities and social sciences can take their place as an integral part of his total education. They do not stand apart from the rest of the curriculum."

The report restates an earlier recommendation of the ASEE: engineering students should spend at least one-fifth of their time studying the humanities and social sciences. The survey committee observes that "Our evidence indicates that a majority of schools do not measure up to this standard; the national average is something less than 17 percent."

The committee also deplores the conflict between arts and engineering faculties that exists in some institutions: "The sober truth is that the attitudes of the engineering faculty communicate themselves to engineering students. At institutions where the faculty exhibited the greatest belligerence about their colleagues in the arts, we invariably found the greatest student complaint about the work in humanities and social studies.

"On the other hand, we have evidence that the conflict disappears almost completely on those campuses where the arts and engineering faculties are thrown together as colleagues on an equal footing."

A grant from the Carnegie Corporation of New York supported the survey, which was directed by George A. Gullette, head of the department of social studies at North Carolina State College. Edwin S. Burdell, president of the Cooper Union, was chairman of the special survey committee that developed the Society for Engineering Education's recommendations on the education of engineers that are contined in the report that has just been released.

Physicists Visit the Soviet Union

With Governmental approval, a group of physicists have accepted the Soviet Union's invitation to a conference of high-energy nuclear physics that will take place in Moscow, 14–20 May. The National Science Foundation will pay travel expenses for most of the group.

The invitations, signed by the U.S.S.R. Academy of Sciences, were sent separately to the following men: Luis Alvarez, Owen Chamberlain, and Emilio Segrè of the University of California; Keith A. Brueckner of Brookhaven National Laboratory; F. J. Dyson and A. Tais of the Institute for Advanced Study; Murray Gell-Mann of California Institute of Technology; Robert E. Marshak of the University of Rochester; John Marshall, Jr., of the Enrico Fermi Institute for Nuclear Studies, University of Chicago; Wolfgang Panofsky of Stanford University; Lyle Smith of Brookhaven National Laboratory; Jack Steinberger of Columbia University; Victor Weisskopf of Massachusetts Institute of Technology; and Robert R. Wilson of Cornell University.

The Soviet Union has also asked some American scientists to attend a conference on the physics of magnetic phenomena that will take place this month in Sverdiovak, Siberia. Those invited include Richard M. Bozorth of the Bell Telephone Laboratories, Charles P. Bean of the General Electric Company, and A. F. Kik of the University of California.

Serotonin and Bleeding

The U.S. Public Health Service has announced that serotonin in the blood, generally considered to be involved in the normal control of bleeding, apparently does not have this function. Serotonin is a substance in brain and intestine, and in blood platelets. Although its presence in the brain has puzzled investigators until recently, there has been an acceptable explanation for the presence of serotonin in blood platelets almost from the time that its action there was discovered in 1918.

Serotonin can constrict blood vessels, and it was thought that its liberation from ruptured platelets at the sites of wounds slowed bleeding and encouraged the formation of clots. This assumption has been challenged by the new research findings.

Research workers in the Laboratory of Chemical Pharmacology of the National Heart Institute have found that by giving reserpine, they can liberate bound serotonin from the blood platelets of laboratory animals. As a result, the platelets are depleted of their serotonin. The time required for wounds to stop bleeding in rats, rabbits, and guinea pigs so treated was the same as that required for untreated animals.

Parkhurst A. Shore, Bernard B. Brodie, and their associates have described this work in a recent issue of the Journal of Pharmacology and Experimental Therapeutics.

AAAS Academy Grants for Student Research

The AAAS announces a new program for the use of the research funds that are awarded by the association to the academies of science. Effective at once, but optional until 1957, the academies are requested to use the grants for the assistance of high-school and college students rather than senior scientists.

Carefully selected students will receive modest amounts to buy equipment or books to assist them in carrying out original investigations. Each recipient will have to report his project in the same way that a senior scientist must when he seeks support from a foundation or a Federal Government agency.

The association believes that experience in original investigation cannot begin too early; further, the solving of even a simple problem in the laboratory or in the field can provide an important stimulus to the young mind.

It should be noted that these grants are not "prizes" for work well done. The emphasis is on the encouragement of, and assistance to, a student who has an idea that he wants to develop. However, students who have already won prizes or awards are not excluded from consideration for grants for new projects.

The academies are being asked to give preference to high-school students. College students in the smaller colleges may be eligible if the college is unable to supply what is needed. Each academy may decide whether equipment purchased for any project is to become the property of the grant recipient or the school or college, or whether it should be turned over to the academy for reissue to other students.

The amount of an academy award depends on the number of members who are also members of the AAAS. The association provides a minimum of \$50 to each participating academy. If all grant funds are not used in a given year, the balance may be spent at any time within 2 years. Students and teachers interested in this new program should communicate with the nearest academy that is affiliated with the AAAS or write to the association for information.—John A. Behnke.

News Briefs

■ The Oceanographic Institution at Woods Hole, Mass., has announced that underwater sounds by baleen whales have been recorded for the first time. The recording was made when three right whales, a variety of baleen whale, spent several days within 10 miles of the institution.

Instead of teeth, baleen whales have growing in their mouths a horny substance called whalebone. It has been known for several years that toothed whales frequently make a great variety of sounds, but attempts to establish this for baleen whales have been inconclusive.

■ The U.S. Atomic Energy Commission has announced that it has reviewed 30,773 research and development reports and informal memoranda in an accelerated program to make more information available to private industry. The review work was done at the Oak Ridge Operations Office by a team of 35 scientists and engineers from major AEC installations. This was a special project within the program for continuous review of all current technical reports that is carried on by the commission as normal procedure.

Of the 30,773 classified reports reviewed, 10,916 were declassified, 8574 were labeled "Confidential," and 11,283

remained in the "Secret" classification. These reports originated in the commission's own installations and in laboratories working under AEC contract.

All documents are being listed as rapidly as possible in "Report Announcement Bulletins." Reports having the highest potential use in the private atomic energy industry will be printed in full-size copy. Others of more limited use will be reproduced in the form of photostats or microcopy.

■ The Institute for Solar-Terrestrial Research has been established at the High Altitude Observatory of the University of Colorado. The institute research program will be carried out by the observatory staff and by invited visitors. A 4-year program has been planned that initially will be devoted to studies of the effects of variable solar activity on weather.

Support for the institute is derived from private sources, including a number of American corporations, foundations, and individuals with special interests in improved weather forecasting. The first year's schedule includes partial sponsorship of a 6-week seminar on solar-weather research that is to be held at Boulder, Colo., 18 June–28 July.

■ The Harvard College Observatory, in conjunction with the Lincoln Laboratory of Massachusetts Institute of Technology, is embarking on an extensive program for the study of meteors by radar methods. The project is under the direction of Fred L. Whipple, and the scientist in charge is Gerald S. Hawkins, who recently arrived from Manchester University in England.

Scientists in the News

STUART W. LIPPINCOTT, professor of pathology at the University of Washington School of Medicine, has accepted a senior appointment in the division of experimental pathology at Brookhaven National Laboratory, Upton, N.Y., and is pathologist for the Brookhaven hospital.

PAUL G. LEFEVRE, who was recently assistant to the chief of the medical branch of the U.S. Atomic Energy Commission, is another new appointee at Brookhaven. He will spend a year in the division of physiology.

OTTO HAHN of Göttingen, Germany, nuclear physicist and president of the Max Planck Association for the Promotion of the Sciences, was awarded the Faraday medal by the British Chemical Society at a ceremony that took place in Nottingham. The award is bestowed every 3 years for special merit in the field of science.

JESSE W. BEAMS, chairman of the department of physics at the University of Virginia, received the Scott medal and premium of the City of Philadelphia during the spring meeting of the American Physical Society.

GEORGE E. PAKE is leaving his post as chairman of the department of physics at Washington University (St. Louis) to join the faculty of Stanford University. Another appointment in physics at Stanford is that of SIDNEY D. DRELL, associate professor, who will return to Stanford after spending the past 4 years at Massachusetts Institute of Technology.

LOUIS M. HELLMAN, chairman of obstetrics and gynecology at the State University of New York College of Medicine in Brooklyn, left on 25 Apr. for a month's visiting professorship at Guy's Hospital Medical School in London, England. On 25 May he will deliver the Green-Armytage Anglo-American lecture on "Tubal plastic operations." This lecture is given every 2 years.

By a joint resolution of the Senate and the House of Representatives, and with the approval of President Eisenhower, three members have been appointed to the board of regents of the Smithsonian Institution.

LEE DEGOLYER is a petroleum geologist, a senior member of the firm DeGolyer and McNaughton, chairman of the board of directors of the Saturday Review of Literature, president of the Dallas Museum of Fine Arts, and a member of the National Academy of Sciences.

CRAWFORD H. GREENEWALT is a chemical engineer, president of the E. I. du Pont de Nemours and Company, and a member of the National Academy of Sciences and the American Philosophical Society.

CARYL P. HASKINS is a research biologist who was long the head of the Haskins Laboratories, Inc., of New York and is now president of the Carnegie Institution of Washington. He is a member of the American Philosophical So-

These new appointments bring to full complement this 14-member board, which by law is composed of the Vice President of the United States, the Chief Justice of the United States, three members of the Senate, three members of the House of Representatives, and six citizen members.

JOEL H. HILDEBRAND, professor emeritus of chemistry at the University of California, delivered Columbia University's ninth annual series of Bampton Lectures in America. FRED W. SCHUELER, associate professor of pharmacology at the State University of Iowa, has received the \$1000 John J. Abel award of the American Society for Pharmacology and Experimental Therapeutics. The award is sponsored by Eli Lilly and Company. In July Schueler will become professor of pharmacology and chairman of the department of pharmacology at Tulane University.

JOHN E. CHRISTIAN, professor of pharmaceutical chemistry at Purdue University, has received the \$1000 award of the Chilean Iodine Educational Bureau. He was honored for his contributions to a better understanding of the pharmacy and chemistry of the radioactive iodine compounds, their application to tracer study techniques, and their use as diagnostic aids.

W. C. NIXON, a staff physicist at the Cavendish Laboratories of Cambridge University, Cambridge, England, is visiting Stanford University during the spring quarter under a National Science Foundation grant. Nixon, who is coinventor of the Coslett-Nixon point focus x-ray tube, is a specialist in x-ray microscopy. He recently completed a 3-month visit to the University of Redlands.

WILLARD F. LIBBY, commissioner, Atomic Energy Commission, has received the scientific achievement medal of the City College Chemistry Alumni Association (New York).

E. ROSS HART, former chief of the neurology branch at the Army Chemical Center, is chief of the new division of neurophysiology and neuropharmacology at the Veterans Administration Hospital, Pittsburgh, Pa.

HENDRIK C. D. DE DECKER, former director of research for Rubber-Stichting, Delft, the Netherlands, has joined the staff of the research and development department of the United States Rubber Company. Two other scientists formerly associated with Rubber-Stichting will also join U.S. Rubber, FEDDE H. D. AKKERMAN and SJIRK VAN DER BURG. All will conduct fundamental research on the chemistry of rubber and plastics.

HARRY Z. MELLINS, assistant professor of radiology at Wayne University Medical School and head of the radiology department at Sinai Hospital in Detroit, has been appointed chairman of the department of radiology at the State University of New York College of Medicine in Brooklyn and director of radiology at Kings County Hospital. He will assume his new post in July.

DAVID B. BALLIN, New York, N.Y.; 64; assistant professor of dermatology at New York University; 15 Apr.

HARRY A. BOGAEV, Philadelphia, Pa.; 63; assistant clinical professor of urology at Jefferson Medical College;

20 Apr.

FREDERIK BØRGESEN; 91; Danish phycologist; authority on the marine algae of the Faeroes, the Danish West Indies, the Canary Islands, Ceylon, India, and Mauritius; 22 Mar.

JAMES H. BRACE, Westmount, Canada; 85; civil engineer; 10 Apr. FREDERICK CLARK, Fairfield, Conn.; 79; mining engineer; 20 Apr.

HARVEY L. CURTIS, Chevy Chase, Md.; 81; retired principal physicist at the National Bureau of Standards; 17

NATHAN S. DAVIS, 3d, Winnetka, Ill.; 66; emeritus associate professor of internal medicine at Northwestern University Medical School; 20 Apr.

GEORGE A. DEAN, Manhattan, Kan.; 83; professor emeritus of entomology at Kansas State College; 23 Apr.

HARRY J. DEUEL, Jr., Pasadena, Calif.; 58; biochemist; dean of the Graduate School of the University of Southern California; representative of the American Society of Biological Chemists on the AAAS Council in 1954 and a member of the AAAS Symposium committee of the Berkeley meeting; recently elected president of the American Institute of Nutrition; 17 Apr.

LAVINIA L. DOCK, Fayetteville, Pa.; 99; leader in establishing nursing as a scientific profession; author of Materia Medica for Nurses published in 1890 and a standard textbook since publication;

CECIL K. DRINKER, Falmouth, Mass.; 69; physiologist; former dean of the Harvard University School of Public Health; authority on lymphatics and blood circulation; 14 Apr.

LEON FLEISCHMANN, New York, N.Y.; 77; civil engineer; expert on struc-

tural standards; 16 Apr.

ALEXANDER FRIEDEN, Milwaukee, Wis.; 60; vice president in charge of research for the Pabst Brewing Com-

pany; 21 Apr.

WILLIAM H. HARRISON, Garden City, N.Y.; 63; electrical engineer and president of the International Telephone and Telegraph Corporation; past president of the American Institute of Electrical Engineers; 21 Apr.

NORMAN F. LE JEUNE, Bayonne, N.J.; 59; chemical engineer; 15 Apr.

EDWARD J. McCARTHY, Westfield, N.J.; 45; electrical engineer for the Bell Telephone Laboratories; 13

ROBERT V. PEGAU, Rahway, N.J.;

59; chemical engineer in the research division of the Foster Wheeler Corporation; 18 Apr.

JOHN P. H. PERRY, New York, N.Y.; 74; civil engineer; former head of the construction and facilities division of the Munitions Board; 14 Apr.

JAMES L. RICHARDS, Wynnewood, Pa.; 63; gynecologist; member of the Jefferson Medical College faculty,

1917-47; 3 Apr.

EDOUARD RIST, Paris, France; 85; bacteriologist; former president of the French Academy of Medicine; internationally known authority on tuberculosis;

MELVIN A. SAYLOR, Philadelphia, Pa.; 81; former professor of chemistry at

Temple University; 11 Apr.

ADOLPH SCHROR; East Orange, N.J.; 82; inventor of turbine and chemical boiler cleaning processes; 21 Apr.

MARY SOROKA, Washington, D.C.;

51; civil engineer; 16 Apr.

JAMES M. TALBOT, Dongan Hills, N.Y.; 73; mechanical engineer and executive vice president of the S. S. White Dental Manufacturing Company; past executive officer of the American Society of Mechanical Engineers; 23 Apr.

FRED E. TIBBETTS, Monument Beach, Mass.; 78; retired civil engineer;

ADRIAAN P. H. TRIVELLI, Rochester, N.Y.; 76; research chemist at the Eastman Kodak Company; 12 Apr.

Education

Winners in the largest private scholarship program in the nation's history have been announced by 19 American corporations and the National Merit Scholarship Corporation of Evanston, Ill. More than \$3 million in scholarships is being awarded to 525 high-school seniors from every state in the nation under the Merit Scholar program. Recipients were selected from among 60,000 students who originally competed for the awards. This year this country has 1 million highschool seniors.

Average worth of each scholarshipsome of which goes directly to the college the winner selects-is \$6000. Each company's Merit Scholar will receive the amount he needs to complete 4 years of college, depending on his financial resources.

Although the Merit Scholar program was initially set up in September 1955 with grants from two leading foundations, the amount of money available for scholarships has increased from \$1 million to the present total because of the participation of private industry. For every dollar contributed to the program by corporations, N.M.S.C. has added a

These corporate donors of the Merit Scholarships are as follows: Sears-Roebuck Foundation, General Dynamics Corporation, Pittsburgh Plate Glass Foundation, McGraw-Hill Publishing Company, General Foods Fund, B. F. Goodrich Company, Boeing Airplane Company, the Gillette Company, Time, Inc., Stewart-Warner Corporation, Food Machinery and Chemical Foundation, Universal Cyclops Steel Corporation, American Cyanamid, Johnson Motor Lines, Standard Rate and Data Service, Inc., Mead Corporation, Standard Oil Foundation, Bryant Chucking Grinder Company, and the Sidney J. Weinberg Foundation.

- A department of biochemistry will be established on 1 Sept. in the Stanford University School of Medicine. The department, which will be located at the university's Palo Alto campus, will be headed by Edward L. Tatum, at present professor of biological sciences.
- Columbia University has announced a teacher-training program, the Scientific Manpower Project, which will be under the direction of Frederick L. Fitzpatrick, head of the department of natural sciences at Teachers College. The Scientific Manpower Project will conduct yearlong workshops for those selected from teacher-training institutions and for some high-school teachers. The first of the workshops begins in the next academic

Participants in the program will attend Teachers College on fellowships made possible by the college and by 25 industries that have contributed \$45,000 toward the \$59,000 that the first workshop will cost.

Forty-nine high school teachers in 10 states and the District of Columbia have been selected by the University of Wisconsin to participate in an experimental program to train science and mathematics teachers. The teachers, all of whom are experienced high-school science and mathematics instructors, will be candidates for master's degrees at the university during 1956-57.

This supplementary training program is sponsored by the National Science Foundation, and is part of a national effort to increase the number of wellqualified science mathematics teachers. Participants will receive a stipend of \$3000 for the academic year, \$300 for each dependent, and free tuition and

travel expenses.

The program was established as a 1-year experiment. Two schools were picked by the foundation to initiate the program-Wisconsin and Oklahoma Agricultural and Mechanical College. Wisconsin received 200 letters of application for the program. Because of this response, NSF is expected to continue the project in 1957-58.

■ Massachusetts Institute of Technology has planned a special summer program on orbital and satellite vehicles 6-17 Aug. The program will be directed by Paul E. Sandorff, associate professor of aeronautical engineering; its purpose will be to provide an over-all assessment of the technology of orbital vehicles of the present.

In addition to members of the M.I.T. faculty the following guest lecturers will participate in the program: Donald H. Menzel, director of the Harvard Observatory, Harvard University; Milton Rosen, head of the Rocket Development Branch, Naval Research Laboratory; William Purdy, project engineer, Glenn L. Martin Company, Baltimore, Md.; Thorp B. Walker, senior engineer, Liquid Engine Division, Aerojet-General Corporation, Azusa, Calif.; Orien L. Hogan, engineer, North American Aviation, Inc., Rocketdyne Facility, Los Angeles, Calif.; James A. Van Allen, chairman, Upper Atmosphere Rocket Research Panel, and head of the department of physics, State University of Iowa; and Hubertus Strughold, head of the department of space medicine, U.S.A.F. School of Aviation Medicine, Randolph Field, Texas.

■ The U.S. Atomic Energy Commission has announced that the commission has approved the construction of two highenergy particle accelerators, one of which will be a joint Harvard University-Massachusetts Institute of Technology project located at Harvard, and the other a joint Princeton University-University of Pennsylvania project located at Princeton. The Harvard-MIT accelerator will be a 6-Bev machine that will cost the Government approximately \$6.5 million. The Princeton-Pennsylvania machine will have an energy of 3 Bev and will be built at an estimated cost to the Government of \$5.8 million. It has been proposed that the machines be made available to scientists from other institutions in addition to those on the staffs of the four participating universities. The facilities will be operated under AEC contracts.

The Harvard-MIT machine will be a circular alternating gradient electron synchrotron, with a 118-foot radius. It will be constructed in about 31/2 years on a site adjacent to the Harvard Cyclotron Laboratory. The Princeton-Pennsylvania accelerator will be a uniform gradient proton synchrotron, to be completed in about 33/3 years at the Forrestal Research Center. It will resemble the cosmotron at Brookhaven National Laboratory but is expected to have a higher beam intensity.

■ The regents of the University of Oklahoma have officially designated the Oklahoma City campus as the "University of Oklahoma Medical Center." A \$400,000 modernization program is now under way there. In addition to being dean of the School of Medicine, Mark R. Everett is now director of the medical

To help teachers cultivate a greater interest in science among elementary and high-school students, New York University will hold a Science Teachers' Workshop, 3 July-10 Aug. The program will be presented by the School of Education, with the assistance of the Graduate School of Arts and Science and the Washington Square College of Arts and Science. The course will include guest lecturers, trips to nearby laboratories, demonstrations and experiments, smallgroup conferences with specialists in science teaching, and individual consultation on effective science teaching at the various school levels.

Grants, Fellowships, and Awards

Fellowship awards totaling more than \$1.1 million, granted to 275 scholars and artists, have been announced by the John Simon Guggenheim Memorial Foundation. This is the largest number of fellowships with the largest total of grants ever announced by the foundation in 1 year. Awards are made to citizens of all the American republics, the Republic of the Philippines, Canada, and the British Caribbean area. A list of the fellows in science follows.

Mathematics and statistics: Clifford A. Truesdell III, professor of mathematics, Indiana University; Edwin E. Moise, associate professor of mathematics, University of Michigan; Joseph L. Hodges, Jr., associate professor of statistics, University of California, Berkeley; Wolfgang H. Fuchs, associate professor of mathematics, Cornell University; Edward W. Barankin, associate professor of statistics, University of California, Berkeley.

Research engineering: Julian D. Cole, associate professor of aeronautics and applied mechanics, California Institute of Technology; Milton C. Shaw, professor of mechanical engineering, Massachusetts Institute of Technology; George Winter, professor of structural engineering, Cornell University; Leonid M. Tichvinsky, professor of mechanical engineering, University of California, Berkeley; Thomas P. Goodman, assistant professor of mechanical engineering, Massachusetts Institute of Technology; Joseph Marin, professor of engineering mechanics, Pennsylvania State University; Israel I. Cornet, associate professor of process engineering, University of California,

Physics: Malvin A. Ruderman, assistant professor of physics, University of California, Berkeley; William S. Rodney, physicist, National Bureau of Standards, Washington, D.C.; Felix M. Villars, associate professor of physics, Massachusetts Institute of Technology; Georges M. Temmer, research physicist, department of terrestrial magnetism, Carnegie Institution of Washington; Jack Steinberger, professor of physics, Columbia University; William F. Fry, associate professor of physics, University of Wisconsin; John H. Reynolds, assistant professor of physics, University of California, Berkeley; Sherman Frankel, assistant professor of physics, University of Pennsylvania; Russell A. Peck, Jr., associate professor of physics, Brown University; Harry W. Fulbright, associate professor of physics, University of Rochester; Gerald C. Phillips, associate professor of physics, Rice Institute, Houston, Texas; Clemens C. J. Roothaan, assistant professor of physics, University of Chicago; David S. Saxon, associate professor of physics, University of California, Los Angeles; Leonard I. Schiff, professor of physics, Stanford University; Harvey Brooks, professor of applied physics, Harvard University; Joseph W. Straley, associate professor of physics, University of North Carolina; James S. Koehler, professor of physics, University of Illinois; Fred H. Schmidt, associate professor of physics, University of Washington, Seattle; Myron A. Jeppesen, professor of physics, Bowdoin College, Brunswick, Maine; M. Avramy Melvin, professor of physics, Florida State University; Charles Kittel, professor of physics, University of California, Berkeley.

Astronomy: John G. Phillips, assistant professor of astronomy, University of

California, Berkeley.

Chemistry: Elias J. Corey, assistant professor of chemistry, University of Illinois; Frank A. Cotton, instructor in chemistry, Massachusetts Institute of Technology; Kurt M. Mislow, assistant professor of chemistry, New York University; Paul D. Bartlett, Erving professor of chemistry, Harvard University; Gene B. Carpenter, assistant professor of chemistry, Brown University; Christian S. Rondestvedt, Jr., assistant professor of chemistry, University of Michigan; William L. Marshall, Jr., senior research chemist, Oak Ridge National Laboratory; Robert L. Letsinger, associate professor of chemistry, Northwestern University; Walter J. Kauzmann, associate professor of chemistry, Princeton University; John E. Kilpatrick, professor of chemistry, Rice Institute; John W. Williams, professor of chemistry, University of Wisconsin; Donald S. Noyce, associate

professor of chemistry, University of California, Berkeley; William E. Truce, associate professor of chemistry, Purdue University; Robert L. Pecsok, associate professor of chemistry, University of California, Los Angeles; Arthur J. Madden, Jr., associate professor of chemical engineering, University of Minnesota; Sigurd W. Melsted, professor of soils, University of Illinois; W. Conrad Fernelius, professor of chemistry, Pennsylvania State University; Walter F. R. Edgell, professor of chemistry, Purdue

Biochemistry: Harold A. Scheraga. associate professor of chemistry, Cornell University; Max Alfert, assistant professor of zoology, University of California, Berkeley; David M. Bonner, research associate in microbiology, Yale University; Allan H. Brown, professor of botany, University of Minnesota; Howard K. Schachman, associate professor of biochemistry, University of California, Berkeley; Sidney Roberts, associate professor of physiological chemistry, University of California Medical Center, Los Angeles; Clara M. Szego, associate professor of zoology, University of California, Los Angeles; Jacob G. Kaplan, associate professor of physiology, Dalhousie University, Halifax, Nova Scotia; Donald M. Reynolds, assistant professor of bacteriology, University of California, Davis; David Shemin, professor of biochemistry, Columbia University; Nathan Kaliss, research associate, Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine; Milton Levy, professor of biochemistry, New York University; Charles Tanford, associate professor of physical chemistry, State University of Iowa; Martin D. Kamen, associate professor of radiochemistry, Washington University Medical School, St. Louis; Cyril H. Long, professor of physiology, Yale University; Herbert Friedmann, curator of birds, Smithsonian Institution, Washington, D.C.; Nicholas Nicolaides, research associate, Department of Medicine, Section of Dermatology, University of Chicago.

Genetics: Spencer W. Brown, associate professor of genetics, University of California, Berkeley; Melvin M. Green, associate professor of genetics, University of California, Davis; Herman B. Chase, professor of biology, Brown University; I. Michael Lerner, professor of poultry husbandry, University of Cali-

fornia, Berkeley.

Microbiology: Arthur L. Cohen, professor of biology, Oglethorpe University, Georgia; Seymour P. Halbert, associate professor of microbiology, Columbia University; Edward A. Adelberg, associate professor of bacteriology, University of California, Berkeley; Harold E. Pearson, professor of public health, University of Southern California and microbiologist, Los Angeles County Hospital.

Biology: Huai C. Chiang, assistant professor of zoology, University of Minnesota, Duluth Branch; William H. Elder, professor of zoology, University of Missouri; Victor C. Twitty, professor of biology, Stanford University; Kanjyo Sakimura, associate entomologist, Pineapple Research Institute, Honolulu, Hawaii; Philip J. Darlington, Jr., curator of insects, Museum of Comparative Zoology, Harvard University.

Botany: Clarence Sterling, assistant professor of food technology, University of California, Davis; Charles A. Schroeder, associate professor of subtropical horticulture, University of California, Los Angeles; Ralph Emerson, professor of botany, University of California, Berkeley; John T. Curtis, professor of botany, University of Wisconsin; William J. Robbins, professor of botany, Columbia University and director, New York Botanical Garden; Frank E. Egler, botanist, Aton Forest, Norfolk, Conn.

Earth sciences: Gustaf O. Arrhenius, assistant research oceanographer, Scripps Institution of Oceanography, La Jolla, Calif.; Francis A. Richards, chemical oceanographer, Woods Hole Oceanographic Institution, Woods Hole, Mass.; Zdenek Sekera, professor of meteorology, University of California, Los Angeles; Ernest Cloos, professor of geology, Johns

Hopkins University.

Paleontology: Arthur J. Boucot, geologist and paleontologist, U.S. Geological Survey, Washington, D.C.; Harry B. Whittington, associate professor of geology, curator of invertebrate paleontology, Museum of Comparative Zoology, Harvard University; Robert W. Wilson, associate curator of vertebrate paleontology and associate professor of zoology, University of Kansas; Kenneth E. Caster, professor of geology, University of Cincinnati; Siemon W. Muller, professor of geology, Stanford University.

Medicine and medical physics: Cornelius A. Tobias, professor of medical physics, University of California, Berkeley; Theodore Enns, assistant professor of medicine, Johns Hopkins University; Heinz Von Foerster, professor, Electron Tube Research Laboratory, University of Illinois; Ralph S. Mackay, Jr., assistant professor of electrical engineering, University of California, Berkeley, and director, Research and Development Laboratory, University of California Medical

Psychology: Mason Haire, associate professor of psychology, University of California, Berkeley.

History of science: I. Bernard Cohen, associate professor of history of science, Harvard University; Gobind B. Lal, science editor emeritus, Hearst newspapers, New York, N.Y.; Charles M. Goss, professor of anatomy, Louisiana State University; Eugene M. K. Geiling, professor of pharmacology, University of Chicago.

- The National Science Foundation has announced that 167 grants totaling \$2,068,600 were awarded during the quarter ending 31 Mar. for the support of basic research in the sciences, for conferences in support of science, for exchange of scientific information, for training science teachers, and for the support of summer and short-term research by medical and other advanced science students. This is the third group of awards to be made during fiscal year 1956. Since the beginning of the program in 1951, 2206 such awards have been made totaling more than \$26 million.
- A new fellowship program designed to provide an opportunity for pediatricians to prepare for an academic career in pediatric education with an emphasis on the social science and psychological aspects of pediatrics will be initiated next fall by the department of pediatrics of the State University of New York Medical Center in Syracuse. The program will make it possible for fellows to participate in conferences, seminars, and clinical experiences with faculty members in the fields of pediatrics, child psychiatry, psychology, social work, sociology, and anthropology. Opportunities to explore psychoanalytic concepts concerning child care and rearing will also be available.

The program provides for a 3-year training period with the appointment of one fellow each year, so that a maximum of three fellows will be in training at one time. Candidates should have completed their residency training in pediatrics.

This program is being supported by a grant from the Commonwealth Fund. Inquiries should be addressed to: Dr. Julius B. Richmond, Department of Pediatrics, State University College of Medicine, Syracuse 10, N.Y.

- The Monsanto Chemical Company, St. Louis, Mo., has announced an expanded program of financial aid to scientific education during 1956-57. A total of 83 American colleges and universities will benefit from 111 awards. When compared with last year's program, these figures show an increase of 30 in the number of schools aided and of 39 in the number of awards made. The awards for the coming year include 29 fellowships, 41 undergraduate scholarships, and 41 cash grants.
- The New York Academy of Medicine has announced that \$1900 of the Louis Livingston Seaman Fund is available for assignment in 1956 for the futherance of research in bacteriology and sanitary science. The amount may be used only for research or scholarships. Ex-

penditures may be made for securing technical help, aid in publishing original work, and purchase of necessary books or apparatus.

The award committee will receive ap-

plications from either institutions or individuals until 1 July. Communications should be addressed to the chairman of the fund, Dr. Wilson G. Smillie, 105 E.

22 St., New York 10, N.Y.

■ Marshall Field Awards, Inc., a nonprofit organization, has been formed "to recognize and reward fundamental and imaginative contributions to the wellbeing of children." Six to nine awards will be made annually to individuals, organizations, and communities in the fields of education, physical and mental development, social welfare, and communications. Each award will consist of \$2000, a scroll, and a statuette. The winners will be selected by a board of directors which, in addition to Field, is composed of 19 authorities in child life.

The areas in which awards will be made cover a broad range of activities related to children: programs and services associated with formal and informal schooling; health, medical care, nutrition, recreation, and rehabilitation; private and public programs in adoption, foster care, delinquency, institutional and day care, and maintaining family income; and publications, advertising, movies, radio, and television.

Under the program, children are defined as those who have not yet reached legal majority. Offices for the new organization have been opened at 598 Madison Ave., New York, N.Y. The deadline for nominations for the first awards is 1 Oct.

• The Lalor Foundation has announced the allocation of 41 faculty summer research awards in the biological sciences. The winners were selected from a group of 115 applicants. The award is approximately \$1100.

Of the 31 awards in the zoological sciences, 12 are in general physiology; five in genetics; four in cytochemistry and microbiology; three in insect physiology; two each in comparative biochemistry, embryology, and endocrinology; and one in ecology. The ten awards in the botanical sciences are eight in plant physiology and two in mycology.

■ Twenty-five new medical research grants have been approved by the National Tuberculosis Association. The grants are in addition to 16 others already in effect and bring to 41 the total number of grants which the NTA is now aiding from Christmas Seal funds. Additional medical research grants are being aided by grants from a number of associations affiliated with the NTA.

■ The National Research Council of Canada has granted 269 scholarships for 1956–57, with a total value of \$345,500. These scholarships include 65 bursaries worth \$800 each, and 155 studentships worth \$1200 each. All of these are to be held in Canada.

Special scholarships awarded for study abroad include 27 awards worth \$2000 each. These special scholarships are to be held in the following countries: nine in the United States of America, 15 in the United Kingdom, one in France, and two in Sweden.

Twenty-two postdoctorate overseas fellowships at \$2500 each have been granted for work in the following countries: 14 in the United Kingdom, one in Germany, three in France, one in the Netherlands, and three in Switzerland.

In the Laboratories

■ The Southwest Research Institute and the Southwest Foundation for Research and Education, San Antonio Tex., have announced that a \$50-million Science City is being built on a 300-acre site surrounding the two institutions. The development will have research facilities and residential and recreational areas.

This scientific center is being provided so that industry may set up advanced research facilities in the Southwest. A \$5-million development program has been started, and an auditorium, a new building for the technical library, a swimming pool, a cafeteria, a golf course, a club house, and a riding stable will be built. The Southwest Foundation for Research and Education has also offered the San Antonio Hospital District Foundation 200 acres for a hospital center within Science City.

Forty large plots have been set aside on the grounds of Science City for industrial research laboratories and high level, technical manufacturing units. Laboratories will either be built to meet specific industrial needs and will be available on a long term lease basis, or companies may lease the land and build their own laboratories.

- A new addition to the chemical research laboratories of the Ethyl Corporation has gone into operation at the company's research and engineering center in Baton Rouge, La. The 18,000-square-foot building will be devoted to research in petrochemicals, chlorination, organometallics, electrochemistry, and other fields.
- The facilities and staff of the Merck Institute for Therapeutic Research have been approximately doubled by the addition of several research groups at West Point, Pa., which were formerly a part of the Sharp and Dohme division of

Merck and Company, Inc. The expanded organization will have a staff of approximately 300, more than half of whom will be professionally trained, with 65 holding the M.D. or Ph.D. degrees.

L. Earle Arnow, formerly vice president and director of research for Sharp and Dohme, has been elected executive director of the Merck Institute. Arnow is also vice president of the Merck Sharp and Dohme Research Laboratories division of Merck and Co., Inc.

Hans Molitor, director of the institute since its founding in 1933, has been appointed director of scientific relations for the Merck Sharp and Dohme Research Laboratories. Molitor was also elected chairman of the board of trustees of the Merck Institute, succeeding George W. Merck, who resigned.

Harry J. Robinson, formerly associate director of the institute, has been appointed director of the Rahway unit, and Karl H. Beyer, formerly head of pharmacological research at Sharp and Dohme, has been appointed director at the West Point unit.

■ The General Electric Company Lamp Division will build an Advanced Lamp Development Laboratory at Nela Park, Cleveland, Ohio, at a cost estimated between \$4 and \$5 million. Ground will be broken this summer, and the structure is expected to be finished late in 1957.

Approximately 150 persons will be employed when the building is opened, but ultimately 250 persons will work in the laboratory. The laboratory staff will include chemists, physical chemists, metallurgists, physicists, and all kinds of engineers.

■ Information for Industry, Inc., Washington, D.C., has announced the availability of a Uniterm index of United States electronics patents. Under this indexing system, complex electronics subjects are reduced to basic words. Information for Industry, Inc., has already applied its Uniterm system to American chemical patents.

The new index of electronics patents will disclose easily and quickly data pertaining to telephony, telegraphy, communications, radar, television, radio, components, instrumentation, nuclear energy, magnetics, vacuum tubes, solidstate devices, propagation, avionics, circuity, miniaturization, automation, printed circuits, facsimile, industrial control, and so forth. With the Uniterm system, it is possible to make both broad and specific searches of electronics patent information; further, the system is expected to provide industry with a common electronics language in research, sales and marketing, product development, and patent evaluation.

Reports and Letters

Influence of the Concentration of Leukemic Inoculum on the Effectiveness of Treatment

Although the clincial treatment of acute leukemia with folic acid antagonists, first employed by Farber et al. (1), is often effective early in the course of treatment, it is generally considered that the ultimate failure of treatment is attributable to the emergence of resistant variants of the leukemic cells, This followed from the development by Burchenal et al. (2) and Law and Boyle (3) of mouse leukemias resistant to folic acid antagonists, such as amethopterin.

In this laboratory, leukemic mice were kept alive for an extended period of time with massive doses of amethopterin. The leukemic cells from such mice, however, showed on transplantation little, if any, evidence of resistance (4). It has also been observed that treatment of leukemic mice with an antagonist of folic acid late in the course of the disease was considerably less effective than treatment initiated early (5). The last-cited observations suggested that failure of treatment could result from an increased population of leukemic cells in the host

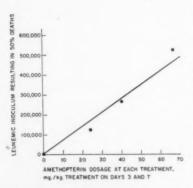


Fig. 1. Relationship between level of treatment with amethopterin and the size of the leukemic inoculum (cells per mouse) required to yield 50-percent mortality (EI...). Early deaths from drug toxicity are excluded in computing the percentage mortality resulting from the leukemic inoculum. Without treatment, the EI no was about 4000 cells.

(4). The current experiment (Fig. 1) demonstrates the importance of the number of leukemic cells in influencing the effectiveness of treatment.

The mice were inoculated intramuscularly with varying levels of leukemic (L1210) cells and were treated intraperitoneally with amethopterin on the third and again on the seventh day following inoculation with the leukemia. Three different dosages of amethopterin were employed, and, in addition, one set of leukemic mice was left untreated.

The mice were observed for mortality for 100 days following leukemic inoculation. Mice that survived 100 days were apparently "leukemia-free." Spleen implants from such mice did not result in leukemic growth. For each treatment level, and for the untreated group, the percentage of mice that died of leukemia increased with increasing inoculum. As the inoculum concentration was increased, it was apparently necessary to increase the dosage of drug to maintain the effect against the tumor.

Figure 1 shows the approximately linear relationship between the number of cells in the leukemic inoculum necessary to kill 50 percent of the mice (EI₅₀) and the dosage of amethopterin. From an EI₅₀ of 4000 cells when no treatment was administered, there was an increase to more than 500,000 cells at the highest dosage of amethopterin employed, a relationship indicating that the level of treatment yielded better than 99-percent inactivation of the leukemic cells. The limitation to the continuation of this positive relationship is the toxicity of the drug to the host. At the highest dosage of the drug (67 mg/kg×2), approximately 20 percent of the mice succumbed to drug toxicity. These animals were excluded from the calculations of

For a specific treatment, administered at a specified time after inoculation of the leukemia, this type of relationship describes the maximal potency of the drug. To improve treatment, it would be necessary to increase the effectiveness of the drug with respect to the leukemia without proportionately increasing the toxicity of the drug for the host. This may be accomplished, for example, by alteration of the schedule of treatment (5, 6) or by delayed administration of citrovorum factor (6).

The data indicate that the effectiveness of treatment is influenced by the number of leukemic cells in the host. Apparently, then, in addition to the possible emergence of resistant leukemic cells, and in addition to other factors, such as the possible diminution in the tolerance of the host to a particular treatment, progressive increase in the number of cells, despite treatment, may render a particular treatment progressively less effective. By the same token, the treatment of advanced leukemia may be hampered by the increased number of

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- 28 December 1955

Natural Selection Associated with the ABO Blood Group

Geneticists have suspected and suggested that human blood groups should be subject to the processes of natural selection (1). Except for hemolytic disease of the newborn, no conclusive evidence that this was so had been brought forward until the article by Aird, Bentall, and Fraser Roberts appeared in 1953 (2). An extensive, well-controlled, clinical study involving population groups throughout England and Scotland demonstrated convincingly the existence of an association between carcinoma of the stomach, peptic ulceration, and the ABO blood group. This report is concerned with the preliminary results of a similar study conducted in the United States. Buchanan and Higley in 1921 (3) and Mayo and Fergeson in 1953 (4), in the only similar American studies, concluded that there was no relationship between blood groups and malignancy and none between blood groups and any disease for which sufficient data were available to justify a conclusion.

The case material utilized in the study reported here was provided by

Table 1. Blood-type frequencies.

Typed		Blood groups											
	Total	0		A		I	3	AB					
		No.	%	No.	%	No.	%	No.	%				
Gastric carcino	ma 879	370	42.09	403	45.85	81	9.22	25	2.84				
Peptic ulcer patients	1770	946	53.45	655	37.01	128	7.23	41	2.31				
Controls	6313	2892	45.81	2625	41.58	570	9.03	226	3.58				

patients seen and treated at the university and five other Iowa hospitals during the past 20 years (5). Unselected, consecutive cases of gastric carcinoma and peptic ulceration are the clinical material upon which this preliminary report is based. A histologic diagnosis, resulting from study of surgical or post-mortem tissue sections, was required for inclusion of carcinoma cases. Duodenal and gastric ulcer cases were included when (i) an iron-clad clinical diagnosis existed that was based on clinical, x-ray and/or gastroscopic findings, or (ii) a gross or microscopic diagnosis was established at the time of surgery or post-mortem examination. In order to insure that these criteria would be rigidly adhered to, all case records were reviewed by one or another of us. The extracted data were transferred to IBM punch-cards and sorted by machine methods. In order to test the significance of our results, they were subjected to statistical analysis by means of the chi-square and differencebetween-percentages methods (6).

It was of the greatest importance to establish reliable values for blood-type frequencies among healthy individuals who were to be used as controls for comparison with the blood-type frequencies observed in the patient groups. The blood types of consecutive blood donors contributing to two hospital blood banks where most patient typings were done were recorded. Before giving blood, these individuals were screened to eliminate those with disorders contraindicating their use as donors. For the most part, they were relatives or acquaintances of the patients. Therefore, most of them came from the same population groups as the patients and had ethnological back-. grounds similar to those of the patients.

The blood-type frequencies and the percentages these represent of the total control and patient groups are recorded in Table 1.

When blood-type frequencies in the control and patient groups are compared, it becomes clear that two significant associations exist. Members of blood type A are either more susceptible to, or have less resistance against, carcinoma of the stomach than members of the three other blood types. The significance of this relationship is at the 2percent level. Members of blood type O, on the other hand, appear to have even greater vulnerability to, or less resistance against, peptic ulceration. The degree of significance here is at the significant level of 0.1 percent.

It is evident that the possession of blood type A is related to natural selection, in that such individuals have a greater probability of developing carcinoma of the stomach and consequently are less favored than members of the other blood types. Conversely, members with these other types are thus favored, except for the selection exercised on group O members by the increased likelihood that they will develop peptic ul-

The association of blood types, the genetics of which have been extensively studied and are well understood, to carcinoma of the stomach fits well with the heretofore suspected familial predisposition to this and other malignancies, A similar genetic factor, acting to cause peptic ulceration, is suggested by the demonstrated predisposition of type O individuals.

The hypotheses that may be advanced to explain these findings seem to fall into one of two general categories-that is, local factors acting in or on the stomach or general ones acting to control the individual's response to the carcinogen or ulcerogen. In the first instance, known mucopolysaccharide blood-group substances may act to increase tissue vulnerability to, or diminish resistance against, carcinogens and ulcerogens. In view of the large number of such substances that have already been isolated, resulting in the definition of the many blood groups, it seems likely that still other similar antigens remain to be identified that could well be responsible for these effects. Local tissue factors and enzyme activities that are unrelated to the red blood cell and its antigens remain less attractive possibilities. Perhaps more appealing, although little evidence thus far has been presented in its support, is the concept of fundamental, individual biochemical and/or physiological differences. Blood types, susceptibility to bacterial organisms, and predispositions to carcinogens and ulcerogens would reflect these fundamental differences in individuals, representing differences in response to similar environmental factors. Evidence that similar relationships do not exist for certain other malignancies and blood types as for carcinoma of the stomach does not rule out this explanation.

A relationship between natural selection and the ABO blood group is indicated by the results of this study through (i) a significant increase of type A among patients with carcinoma of the stomach, and (ii) a significant increase of type O among patients with peptic ulceration.

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- The statistical analysis was made by L. A. Knowler, department of mathematics and as-tronomy, State University of Iowa, Iowa City.
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Salivary Amylase in the Rat

In a review of the literature concerning amylase in the body fluids and tissues of the rat, no good quantitative data could be found on salivary amylase levels. Several sources (1, 2) agreed that the rat does have amylase in its saliva but gave little other information. Quantitative data, of interest in this laboratory in connection with a larger study (3) on tissue amylases, have now been obtained and are reported here.

Fifteen Sprague-Dawley rats, fed on the usual laboratory diet, were used in this study. With the rats under ether anesthesia, flow of saliva was stimulated by intraperitoneal injection of approximately 1 mg/kg of pilocarpine (4). Saliva was collected by gentle suction on a micropipette leading to a small trap. By this means, 0.3 to 0.5 ml of saliva could be collected in 10 to 15 minutes. After saliva had been obtained, the rats were sacrificed, and blood was collected for serum amylase determinations.

Both salivary and serum amylase determinations were carried out by the method of Van Loon (5) (Van Loon's amylase units are numerically equal to Somogyi amylase units), using 1/100 dilutions of serum and 1/20,000 dilutions of saliva instead of the usual 1/10 dilution that is recommended for human serum. In an earlier study in this laboratory, human salivary amylase levels were found to be 50,000 to 200,000 units/100 ml, and 1/5000 dilutions of saliva were appropriate in the analyses. Incidentally, no diastaticlike action of pilocarpine (6) on starch or other interference with salivary amylase determination was noted.

The data in Table 1 show that there are wide variations in rat salivary amylase levels, but it is apparent that the average (626,000) is still several times that in human saliva. Thus, contrary to previous statements (2), man does not have "the highest ptyalin concentration of all animals."

These data on rats were of interest in view of the report (7) that in depancreatized rats, serum amylase levels and urinary amylase excretion remain essentially the same as in normal rats. Thus, some organ or organs other than the pancreas must be a source of rat serum amylase. The salivary glands might conceivably be such a source. However, comparison of salivary and serum amylase levels in rats showed little correlation. Also, in a rat that was sacrificed in this laboratory on the seventh day after surgical removal of its salivary glands, the serum amylase fell only slightly. The serum amylase preoperatively was 2500; 7 days postoperatively, it was still 1800. Since, with no saliva, the rat experienced some difficulty in eating, the fall in serum amylase level could be explained on a purely nutritional basis. Saline

Table 1. Salivary and serum amylase in

Amyla (Van Loon uni	Salivary/	
Salivary	Serum	serum
1,340,000	4280	312
1,300,000	4810	270
1,180,000	4070	290
1,000,000	4070	245
750,000	4150	181
670,000	4230	158
630,000	3660	172
617,000	4400	140
510,000	3310	154
361,000		
307,000	3740	82
247,000	3660	67
205,000	4060	50
181,000	*	
91,000	3740	24

^{*} Samples lost

washings of this rat's mouth showed no trace of amylase activity.

As one might have predicted, the amylase in rat saliva is apparently an a-amylase. Its action on soluble starch produced the progressive changes to the amylo-, erythro- and achrodextrin stages (as followed by the iodine reaction) that are typical of the action of a-amylase but not that of \beta-amylase.

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19 October 1955

Synthesis of 5-Hydroxypipecolic Acid and Separation of Its Diastereoisomers

The metabolic and structural relationships between ornithine and proline (1), hydroxyornithine and hydroxyproline (2), and lysine and pipecolic acid (3) prompted us to convert 8-hydroxy-Llysine to 5-hydroxypipecolic acid, the homolog of hydroxyproline. This amino acid has recently been isolated from Rhapis flabelliformis (4) and has been obtained as an intermediate in the synthesis of baikiain (5).

8-Hydroxy-L-lysine containing 18 percent allohydroxy-D-lysine (6) was treated with 1.5 equivalents of nitrosyl chloride in 6N hydrochloric acid and kept at 60°C for 25 minutes. The reaction mixture was assayed for total nitrogen (Kjeldahl) and for a-amino nitrogen by evolution of carbon dioxide after oxidation with chloramine-T (7). It was found that about one-half of the total nitrogen was present as a-amino nitrogen. Assuming little or no formation of the a, e-dichlorocaproic acid, it follows that approximately equal amounts of the α-chloro and ε-chloro acids were formed. The mixture was cyclized by bringing the aqueous solution to a pH of 11 with barium hydroxide and warming on the steam bath for 10 minutes.

The products of this reaction were studied by ion-exchange chromatography in an attempt to separate the diastereoisomers. The methods were patterned after those of Moore and Stein (8). A 150- by 0.9-cm column of Dowex 50-X8, 200 to 400 mesh (rescreened, wet, through 200 mesh), operated at room temperature and 4 ml/hr, was employed. Elution was started from a mixing chamber containing 130 ml of 0.3M citrate buffer (0.2N in sodium citrate) at pH 3.00. The pH was gradually increased by adding 0.2N sodium citrate to the buffer at a rate equal to one-half the elution rate. Buffer and citrate solution contained 1 percent of a detergent solution (8). One-milliliter fractions were collected. 5-Hydroxypipecolic acid was determined (9) by adding 1 ml of 2-percent ninhydrin in glacial acetic acid and placing the tubes in a boiling water bath for 15 minutes. After the mixture had been diluted with 5 ml of acetonewater (50/50 by volume), the concentration was determined from the absorbancy at 353 mu.

Figure 1 shows a portion of the effluent curve that was obtained by chromatography of the reaction mixture from the cyclization of hydroxylysine. By admixture of an authentic sample of 5-hydroxy-L-pipecolic acid obtained from dates (9) or material kindly provided by A. I. Virtanen (4), the faster moving peak was identified as the natural isomer. The other peak was presumably the allo form since it showed an absorption spectrum after reaction with ninhydrin in glacial acetic acid identical with that obtained with the natural isomer. This was the same order of appearance as that observed for the diastereoisomers of hydroxyproline (10) on an ion exchange column, and it may be taken as a suggestion of the trans arrangement for the functional groups of 5-hydroxy-L-pipecolic acid. The yield from the cyclization reaction was only 2 to 5 percent.

Paper chromatography was also used to characterize the products of the cycli-

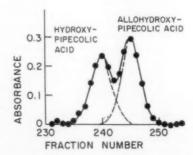


Fig. 1. Ion-exchange chromatography of the products of cyclization of 8-hydroxylysine showing the separation of the diastereoisomers of 5-hydroxypipecolic acid.

zation reaction. The methods described by Irreverre and Martin (11) were employed. Authentic 5-hydroxy-L-pipecolic acid gave a spot just to the left of proline (refer to Fig. 5A, of Irreverre and Martin, 11). The R value (relative to alanine) was 1.31 in t-amyl alcohol-2,4-lutidine. The ninhydrin color was bright purple, fading to yellow over several days. Under ultraviolet light, it fluoresced bright cherry-red, or reddish-orange at lower concentrations. A greenish-blue color was produced with isatin. The reaction mixture from the cyclization of hydroxylysine showed this same spot. Another spot, identical in every respect, appeared slightly lower on the chromatogram. The R value was 1.00 in the basic solvent. It seemed probable that the diastereoisomers had separated on the paper. This hypothesis was tested by chromatographing hydroxy-L-proline and allohydroxy-p-proline. These diastereoisomers separated to approximately the same degree and in the same direction. The R values were 1.04 and 0.83 in the basic solvent. Also, authentic 5-hydroxy-1.-pipecolic acid showed only the lower spot after inversion to allohydroxy-Dpipecolic acid. The inversion was accomplished by refluxing with acetic anhydride containing acetic acid (12) and subsequent hydrolysis.

A large, immobile spot was also present on the paper chromatograms of the cyclization mixture. This probably represented linear polymerization of the monochloro acids which could have accounted for the low yield of 5-hydroxypipecolic acid. Studies on the stereochemistry of 5-hydroxy-L-pipecolic acid

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- 19 October 1955

Effects of Intravenously Administered Fat on the Serum Lipoproteins

It has been shown in our laboratories that daily intravenous infusions of a fat emulsion cause a significant decrease in the elevated serum lipid values of patients with idiopathic hyperlipemia or primary hypercholesteremic xanthomatosis (1). In order to study these effects in more detail, electrophoretic analyses of serum were carried out in eight normal human beings and in eight dogs before and after an intravenous infusion of emulsified fat (2).

The human beings were given a single intravenous infusion of an emulsion containing in a total volume of 500 ml either 50 g of cottonseed oil or 50 g of synthetic triolein, with soybean phosphatide, pluronic, and dextrose added as emulsifying and stabilizing agents (3). The dogs weighed about 15 kg and were given 300 ml of this emulsion. The time for the infusion averaged 4 hours in the human beings and 2 hours in the dogs. Blood samples were taken before and at the end of the infusion as well as for several hours afterward. Samples of serum were analyzed by paper electrophoresis as de-

scribed previously (4). In the eight human beings, the paper strips stained for lipids showed, prior to the infusion, two bands: (i) an intensely stained band in the beta globulin area, corresponding to the beta lipoproteins, and (ii) a less intensely stained band intermediary between alpha-1 globulin and albumin, corresponding to the alpha lipoproteins. At the end of the intravenous infusion, the beta lipoprotein band showed a densely stained trail extending back to the starting line, representing the chylomicrons. In addition, both lipoproteins moved faster: the beta lipoproteins moved either with a speed intermediary between beta globulin and alpha-2 globulin or with a speed of alpha-2 globulin (Fig. 1). The alpha lipoproteins in some subjects were split into two components, the larger component migrating with the speed of albumin and the other smaller component migrating ahead of albumin; in other subjects, all alpha lipoproteins migrated together as a broad band ahead of albumin. On the corresponding proteinstained paper strips, small amounts of

protein were seen ahead of albumin, representing the protein moiety of the alpha lipoproteins. The increase in the electrophoretic mobility of the alpha and beta lipoproteins persisted for about 2 hours after the end of the infusion.

In the eight dogs, fasting serum samples showed on the lipid-stained paper strips an intensely stained band in the area between albumin and alpha-1 globulin, representing the alpha lipoproteins. In five dogs, small amounts of beta lipoproteins were present in the beta globulin region; in three dogs, no visible amounts were present. At the end of the infusion, the lipid-stained paper strips showed a densely staining trail extending to the starting line, representing the chylomicrons. In those dogs in which beta lipoproteins had been present in visible amounts prior to the infusion, they then migrated with increased speed in the region of alpha-2 globulin. The alpha lipoproteins were found in all instances ahead of albumin as a broad band on both the lipid- and the protein-stained paper strips.

So far, we have not been able to demonstrate electrophoretic changes in the serum after oral feeding of the fat emulsion, possibly because the concentration of lipids in the serum of the test persons did not rise as high as it did after the intravenous infusion.

The importance of the observed electrophoretic changes following the infusion of the fat emulsions lies in the fact that the changes are identical with those induced by the intravenous injections of heparin in normal persons during alimentary hyperlipemia (4, 5) and in patients with idiopathic hyperlipemia even when fasting (4, 6). In addition, in patients with idiopathic hyperlipemia, an injection of heparin had caused a de-

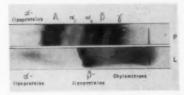


Fig. 1. Paper electrophoretic pattern of human serum obtained at the end of an intravenous infusion of fat. Upper half of the strip is stained for proteins (P), lower half is stained for lipids (L). On the lipidstained paper strip, the beta lipoproteins, normally present in the beta globulin area, move now with the speed of alpha-2 globulins. The alpha lipoproteins, normally present in the area between albumin and alpha-1 globulins, move now ahead of albumin. On the protein-stained paper strip (P), small amounts of protein migrate ahead of albumin, representing the protein moiety of the alpha lipopro-

crease in the serum lipids (7). In the case of heparin, the electrophoretic changes and the reduction in the serum lipids are produced by the action of a "clearing factor" that is a heparin-activated lipoprotein lipase (8). It remains to be determined whether the infusion of a fat emulsion also activates this lipoprotein lipase or has a different mode of action.

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Pyridine Nucleotide Analogs and the Sulfhydryl Nature of Some FAD Enzymes

It has recently been demonstrated by Kaplan and Ciotti (1) that pig brain DPNase will catalyze an exchange between the nicotinamide moiety of DPN (2) or TPN and 3-AP, resulting in the formation of APDPN or APTPN. These analogs have been shown to be active in a number of dehydrogenase systems (3). The average potential of APDPN/ APDPNH has been found to be approximately 0.08 v more positive than the DPN/DPNH system. It was therefore of interest to determine whether flavin enzymes could catalyze a transfer of hydrogen or electrons from DPNH or TPNH to the respective 3-AP analogs

All measurements were performed using a Beckman DU spectrophotometer with 3.0-ml cuvettes having a 1.0-cm light path, and all reactions were run at room temperature. APDPNH and

APTPNH formation was determined by an increase in optical density at their maximum extinction at 365 mu and at 400 mµ, where they have significant absorption in contrast to DPNH and TPNH.

Reaction mixtures contained 50 µmoles of phosphate buffer, pH 7.5, and 50 umoles of trisodium citrate dihydrate. In addition, the diaphorase reaction mixtures contained 0.25 µmoles of DPNH, 0.6 µmoles of APDPN, and 0.09 mg of enzyme protein in a total volume of 3.0 ml. The cytochrome-c reductase reaction mixtures contained 0.22 µmoles of TPNH, 0.53 µmoles of APTPN, and 0.2 mg of enzyme protein in a total volume of 3.0 ml. Additions of pCMB and GSH are noted in Table 1 as final molar concentrations. When pCMB was used it was incubated with the enzyme in the phosphate buffer for 5 minutes at 0°C. In measuring GSH reversal of pCMB inhibition, GSH was incubated for another 5-minute period before testing. All reactions were started with APDPN for the diaphorase and APTPN for the cytochrome-c reductase.

It was found that Straub's DPNH diaphorase (5), a FAD enzyme from pig heart that catalyzes the reduction of dye and inorganic iron (6) also catalyzes a transfer of hydrogen or electrons from DPNH to APDPN, as is indicated by Eq. 1.

$$DPNH + APDPN^* \rightarrow DPN^* + APDPNH$$
(1)

This transfer occurred only in the presence of DPNH and APDPN. TPNH and APTPN would not serve as electron donor or acceptor, respectively, with the diaphorase. Investigation of the involvement of sulfhydryl groups in this reaction, as shown in Table 1, revealed that pCMB inhibited the transfer reaction. This inhibition could be reversed with GSH. The catalysis of dye reduction by this enzyme was also inhibited by pCMB. GSH reversal was not attempted, since the dve is reduced nonenzymatically by GSH.

TPNH cytochrome-c reductase (7), a FAD enzyme from pig liver, also catalyzes this transfer reaction, as is given by Eq. 2.

$$\mathsf{TPNH} + \mathsf{APTPN^{\diamond}} \to \mathsf{TPN^{\diamond}} + \mathsf{APTPNH}$$

However, with this enzyme, DPNH and APDPN would not serve as electron donor and acceptor, respectively, but required TPNH and the corresponding analog APTPN for transfer. As can be seen in Table 1, pCMB inhibited the transfer reaction, and the inhibition was reversed by GSH. Since this enzyme catalyzes the transfer reaction at a much

Table 1. Inhibition by pCMB of diaphorase and TPNH cytochrome-c reductase catalyzing the reduction of APDPN by DPNH and APTPN by TPNH, respectively, and the reversal by GSH.

Reaction mixtures	Diaphorase (µmoles APDPNH formed in 3 min)	TPNH cyto- chrome-c reductase (µmoles APTPNH formed in 60 min)
Control	0.229	0.172
Plus pCMB (2×10-4M)	0	0
Plus pCMB (2×10-4M) plus GSH		
(10 ⁻³ M) Plus GSH	0.234	0.172
$(10^{-8}M)$	0.233	0.172
Minus enzyme plus GSH (10 ⁻³ M)	0	0
Minus DPNH or TPNH plus GSH	U	
$(10^{-3}M)$	0	0

slower rate than the diaphorase, a 60minute period was used to determine the formation of APTPNH rather than the 3 minutes employed for the diaphorase. The reduction of cytochrome c was also inhibited by pCMB.

These results demonstrate that, in all probability, sulfhydryl groups are involved in the catalytic properties of DPNH diaphorase and TPNH cytochrome-c reductase.

Other FAD enzymes such as pig heart DPNH cytochrome-c reductase (8), Neurospora TPNH nitrate reductase (9), milk xanthine oxidase, and the DPNH oxidase from Clostridium kluyveri (10) catalyze these transfer reactions, and demonstrate specificity toward both the reduced pyridine nucleotide and acceptor analog. Nonflavin dehydrogenases and FMN enzymes tested did not appear to catalyze this reaction.

Preliminary experiments indicate that, although only the FAD enzymes tested were active, FAD does not appear necessary for this transfer reaction. In view of this, it is of interest to speculate that FAD enzymes are in such configuration that the reduced pyridine nucleotides can transfer hydrogen or electrons directly to the protein. This reduced protein can then transfer hydrogen or electrons to the specific pyridine nucleotide analog without the involvement of flavin as an intermediate. In reactions involving reduction of dye or cytochrome c, the reduced protein would transfer hydrogen or electrons to FAD and then on to dye от cytochrome.

It is of interest to note that, although all the FAD enzymes studied appear to be sulfhydryl enzymes, as demonstrated by pCMB inhibition of reactions involving the reduction of dye and cytochrome c, they all were not inhibited by pCMB in catalyzing the transfer reaction. The transfer reactions from TPNH to APTPN catalyzed by nitrate reductase and from DPNH to APDPN catalyzed by the DPNH oxidase from Cl. kluyveri, respectively, were not inhibited by pCMB. Milk xanthine oxidase catalysis of hypoxanthine oxidation by oxygen and dye is inhibited by pCMB (11). When hypoxanthine and APDPN are used as electron donor and acceptor, respectively, inhibition of the reduction of APDPN is accomplished with pCMB and reversed with GSH. If, however, DPNH is used as electron donor, dve reduction and the transfer reaction are not inhibited by a concentration of pCMB, which would inhibit when hypoxanthine was used as electron donor. This is interesting in view of the belief of Mackler et al. (12) that all reactions catalyzed by their xanthine oxidase preparations are attributable to one protein.

The involvement of a reduced protein in flavoprotein reactions is now under

investigation.

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respectively; FMN and FAD, flavin mononucleotide and flavin adenine dinucleotide, respectively; \$\rho(MB, \rho)\$-chloromercuribenzoate; GSH, glutathione.

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International Cooperation in Radiobiology through an Agency Sponsored by the United Nations

The following reasons for international cooperation in radiobiology may be considered.

1) The running of numerous power reactors in many countries is going to increase the radioactivity of the atmosphere, the soil, and the waters. It is difficult to establish which level of constant radioactivity is dangerous for man and animals; concentrations of 1/500,000 of phosphorus-32 in fishes (as compared with water) were reported at the Geneva Conference on the Peaceful Uses of Atomic Energy. Possible damages are not limited to the country where the reactor is located; this fact may be the origin of bitter international discussions if measures are not taken beforehand.

The carcinogenic and genetic effects of ionizing radiations on nonhomogeneous populations are unknown and theoretically unpredictable. Different types of research are already contemplated to solve this question; these projects should be discussed on an international basis because they are extremely costly and time

consuming.

On the genetic problem of irradiated human populations, T. C. Carter said (A/Conf. 8/P/449), "We now need a research program with three main parts: fundamental studies of mutation; studies of animal populations; and studies of human populations. Such a program would have to be on a very lavish scale and parts of it would almost certainly require international cooperation."

2) Biologists have a great responsibility in the development of peaceful uses of atomic energy. Physicists and industrialists must not disregard the warnings of the biologists despite the fact that these warnings may tend to put limits to their

Some people have interest in emphasizing the biological dangers of radioactivity; others have interest in neglecting them. Margins of safety must be established and constantly revised not only by scientists meeting around a table once a year, but also by their actually working together.

3) Basic discoveries in radiobiology may have important consequences for the generalized use of atomic energy. For instance, the possibility exists of increasing, by chemical substances, the resistance of man to ionizing radiations. The phenomenon of chemical protection against these radiations has been repeatedly demonstrated in animals. Efficient treatment (actually lacking) of accidentally irradiated human beings depends entirely on active pursuit of promising researches in animals. International

agreement should be reached before the use of a protector or a treatment is widely advocated. Controls of the experiments and of the substances themselves should be put on an international basis.

4) Countries that do not like to depend on big atomic powers would find in an International Laboratory of Radiobiology a suitable place for obtaining information and training for their scien-

5) The spirit of collaboration that was prevalent during the Geneva Conference on the Peaceful Uses of Atomic Energy should be perpetuated by the presence, in the same International Laboratory, of biologists from many countries. One may hope that international cooperation would speed up biological research, thus enabling us to keep up with the industrial development of atomic energy and prevent irreparable damage to the human

As shown by the Geneva Conference, the whole human race is involved in the widespread use of atomic energy. Many basic biological data are not yet available that would enable us to appreciate the dangers and the possibilities of overcoming them either by protection or by therapeutics. It seems to be the duty of an International Atomic Agency to have at its disposal a body of biologists who are organized in some kind of international institution where facilities for laboratory work would be available.

Z. M. BACO

University of Liège, Liège, Belgium 25 October 1955

Since the foregoing note was received, the United Nations has established a Scientific Committee on the Effects of Atomic Radiation, which met in New York 14-23 March 1956. The recommendations of the committee, which include many of the suggestions made by Z. M. Bacq, were re-leased 9 April 1956 and will be summarized in the 25 May issue of Science.

Myo-Inositol as an Essential Growth Factor for Normal and Malignant Human Cells in Tissue Culture

It has been shown (1) that two mammalian cells, a human carcinoma of the cervix (strain HeLa) and a mouse fibroblast (strain L) can be propagated in a medium embodying 13 amino acids, seven vitamins, five salts, glucose, and a varying amount of serum protein, the latter supplied either as whole or dialyzed serum. Each of these components was demonstrably essential for survival and growth. It was subsequently found that a number of other human cell lines, both normal and malignant, could be

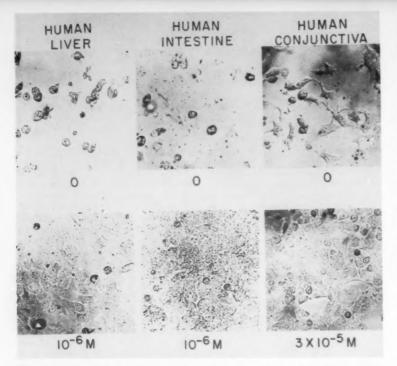


Fig 1. The early death of three normal human cells in the absence of inositol, and their normal growth on its addition to the medium.

Table 1. The inositol requirement of 19 cell lines in tissue culture.

Tissue of origin	Strain identification	Inosi- tol require- ment	Maximally effective concn.,	
Human carcinoma of cervix	HeLa (Gey)	0(?)		
Human monocytic leukemia	J-111 (Osgood)	0(3)		
Mouse fibroblast	L-929 (Earle)	0		
Human epidermoid carcinoma of throat	KB (Eagle)	+	2×10^{-6}	10-5
Human bone marrow	D	4	3×10^{-7}	1-3 × 10 ^{-a}
(w/metastatic cancer)	Detroit 6 (Stulberg)	+	3×10^{-7}	$1-3 \times 10^{-6}$
Human carcinomatus ascites	Detroit 30a (Stulberg)	+	3 × 10	1-3 × 10
Human bone marrow	D	+	3 × 10 7 ±	10-6
(w/metastatic cancer) Human bone marrow	Detroit 32 (Stulberg)	-	3 ~ 10 2	10
A R MARKET TO THE PARTY OF THE	Detroit 32 (Stulberg)	+	3×10^{-7}	10 ^{-a}
(normal) Human carcinomatus ascites	Detroit 52 (Stulberg) Detroit 56a (Stulberg)	+	3×10°±	10-6
	Detroit Joa (Stutoerg)	-	3 ~ 10 2	10
Human malignant lymphoma (cells from pleural fluid)	Detroit 116P (Stulberg)	+	$3 \times 10^{-7} \pm$	$1-3 \times 10^{-6}$
Human bone marrow	Detroit 1101 (Studers)		3 110 2	1 3 10
(w/metastatic cancer)	Detroit 34 (Stulberg)	4	3 × 10 ⁻⁷ ±	10-8
Human liver	Chang	+	3 × 10-7	10-4
Human liver	Henle	+	2×10^{-7}	10-4
Human embryonic intestinal	reme		410	10
epithelium	Henle	+	2×10^{-7}	10 ^{-a}
Human conjunctiva	Chang	+	3×10^{-7}	10 ^{-a}
Human foreskin	Leighton	4	3 × 10 ⁻⁷	10-0
Human embryonic fibroblast	MAF 66 (Microbio- logical Assoc.)	+	10 ^{-a} ±	3 × 10 ^{-a}
Mouse adenocarcinoma	logical rasoci)		=	
("Sarcoma")	S-180	+	2 × 10 °	10-6
Human bone marrow			,	
(normal)	Detroit 98 (Stulberg)	+	$3 \times 10^{-7} \pm$	10 °

^{*} Concentration permitting 50 percent of maximum growth.

propagated in the same basa! medium, but only when it was supplemented with 10 percent whole human serum; when the latter was replaced by dialyzed serum, most of these cell strains died, either in the very first passage or on subdivision. When the dialyzed serum was supplemented with an equivalent amount of serum ultrafiltrate, normal growth was obtained. The dialyzable factor of serum required by these cells, over and above the 26 essential components previously identified, could be wholly replaced by myo-(meso-)inositol and presumably was either the compound or a dialyzable derivative of it.

A total of 19 cell lines (17 human and two mouse) have now been studied with respect to their inositol requirement (see Table 1). Seven cultures derived from cancer tissue, nine derived from normal tissue, and three cultures were obtained from the bone marrow of patients with metastatic carcinoma. Of these 19 cell lines, the nine that are listed in the bottom section of Table 1 failed to grow even on the first subculture in an inositolfree medium (see Fig. 1). The seven lines listed in the middle section of the table grew for a period of 5 to 7 days but regularly died on subculture. With the addition of inositol, however, all 16 lines grew at a normal rate, and all continued to grow at a normal rate on serial subculture. The contrast between the death of these cells in an inositol-deficient medium and their rapid growth in the same medium supplemented with inositol is illustrated for three normal cells in Fig. 1. The amounts of inositol required by these 16 cell lines were remarkably consistent, the concentrations necessary for maximum growth varying between 10-5 and 10-6M (Table 1).

Of the three remaining cell lines, the mouse fibroblast has to date given no indication of an inositol requirement and has been carried for months in an inositol-free medium, supplemented with 1 percent dialyzed serum. Inconsistent results have, however, been obtained with the remaining two cell lines (HeLa strain, human leukemia J-111). In several experiments these two strains were propagated for 6 to 8 weeks in an inositol-free medium, maintaining an average generation time of approximately 48 hours. Occasionally, however, the HeLa cell has failed to give sustained growth in a medium supplemented with dialyzed serum unless inositol was added; and similarly inconsistent results have been obtained with the J-111 leukemia cell.

Inositol has been shown to be essential for the survival and growth of a number of microorganisms (2). However, as Schopfer (3) has pointed out, although myo-inositol was perhaps the first of the microbial growth factors to be discovered, it is one of the last to be identified as a vitamin in animal metabolism.

Its metabolic function remains obscure, although it is suspected to have a lipotropic effect independent of that of choline (4).

Inconsistent results have been obtained in attempts to produce symptoms of inositol deficiency in animals. In mice, alopecia was produced in approximately half the animals (5); and in rats also inositol caused a positive growth response and prevented and cured a generalized alopecia (6). More recently, however, inositol was not found to have a demonstrable effect in the growth of rats on an amino acid-sucrose-corn oil-saltvitamin diet (7). Similarly conflicting results have been reported with respect to its possible relationship to the "spectacle eye" syndrome in rats (8). A growth-promoting effect has been noted in cotton rats (9); and the omission of both inositol and PABA from the diet of golden hamsters led to the death of some of the animals (10). In man there has been no evidence of an inositol requirement.

The demonstration of its vitamin function in animals or man is complicated by its possible production by the intestinal flora (11) and by its partial biosynthesis (12) and is further complicated by the reported dependence of its effects on the presence or absence of other

B vitamins (13). Under these circumstances, the present demonstration that inositol is an essential growth factor for a wide variety of human cell lines in tissue culture is of particular significance. The effective concentrations, higher than those of most of the other essential vitamins, are of the same order of magnitude as the choline requirement of the mouse fibroblast. Whether inositol is used as a metabolite -for instance, for incorporation into phospholipides-or whether it functions as a vitamin remains to be determined, as does the degree to which it can be replaced by its isomers or by related compounds. To date, no compound has been found capable of substituting for myoinositol.

Contrary to some of the results obtained in animals, the presence of pantothenic acid in the medium did not obviate the need for inositol, and the addition of PABA similarly had no qualitative or quantitative effect. It is of interest also that, although inositol has been reported to have a carcinolytic action in experimental animals (14), in the present experiments it was essential for the growth of five of the seven tumor lines tested.

When inositol was added to the 26 essential factors previously identified, every cell line here described could be grown for long periods in a medium supplemented only with serum protein. It thus becomes possible to determine the specific amino acid and vitamin requirements of all these human cell lines, deriving from a variety of normal and malignant tissues, with a view to ascertaining possible quantitative or qualitative differences.

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Biochemical Action of CDAA. a New Herbicide

One of the more active herbicides that has been discovered since the introduction of 2,4-dichlorophenoxyacetic acid is α-chloro-N,N-diallylacetamide (CDAA) (1). This herbicide, which has only recently been announced, is grass-specific and preemergent. It is also extremely selective, affecting only certain members of the monocotyledons and dicotyledons. For example, when it is applied at the appropriate dosage, it will destroy giant foxtail and pigweed in either corn or soybean fields without injuring the crop.

The mode of action of such a selective herbicide is of sufficient interest to warrant studies of the respiratory processes in moderately susceptible and susceptible plants (wheat and ryegrass, respectively). Germinating seeds of wheat and ryegrass

were treated with CDAA at 10 ppm in the absence and presence of sulfhydrylcontaining compounds. The data in Table 1 on oxygen uptake, changes in respiratory quotients, and growth show that ryegrass seeds are more susceptible to CDAA than wheat seeds. This finding is in agreement with results obtained from greenhouse studies. The possibility exists that the site and/or mode of action of CDAA in wheat is different than it is in ryegrass since the respiratory quotient of wheat was increased in the presence of this herbicide, whereas the respiratory quotient of ryegrass was markedly decreased.

The reversal studies suggest that sensitive sulfhydryl enzymes in both wheat and ryegrass are inhibited by CDAA, and this reaction could be related to the classical alkylation of sulfhydryl groups by iodoacetate and iodoacetamide (2-3). The reversal produced by calcium pantothenate was attributed to its conversion to coenzyme A. Reversal studies with coenzyme A per se were not significant; however, this may have been caused by an inability of the nucleotide to penetrate the seed at the proper site.

Since the growth of wheat and ryegrass seedlings was almost completely inhibited despite the observed effects on the respiratory quotients and respiration rates, a simple detoxification of CDAA by inter-

Table 1. Influence of α-chloro-N,N-diallylacetamide (CDAA) on the respiration, respiratory quotients, and growth of germinating wheat and ryegrass seeds. The respiratory quotients were determined according to the "direct method" of Warburg (3).

Compound* and concn. (ppm)	O2 uptake [µlit/hr 100 mg of tissue (wet wt.)]	Respiratory quo- tient	Coty- ledon- ary growth after 120 hr (mm)
Wheat			
Control	49.0	0.96	16.9
CDAA (10)	38.0	1.12	0.8
GSH (15)	42.0		15.5
CDAA (10) + GSH (15)	45.0		1.0
Ryegrass	100	1.00	
Control	16.0	1.00	21.3
CDAA (10)	3.4	0.62	0
GSH (15) CDAA (10) +	17.4	0.96	20.6
GSH (15)	18.8	0.94	0
Ca-pan (15) CDAA (10) +	16.8	1.02	19.3
Ca-pan (15)	11.0	1.05	0
α-lipoic acid (4) CDAA (10) + α-	16.0	1.02	21.5
lipoic acid (4)	11.5	1.07	0

The abbreviations represent the following: GSH. reduced glutathione; Ca-pan, calcium par

action in the media with the reversing agent could not have occurred. Growth was not restored by placing the seeds in water following the 48-hour treatment with the various mixtures tested.

On the basis of the results obtained, it appears that CDAA inhibits certain sulfhydryl-containing enzymes that are involved in respiration. It further appears that it affects a mechanism even more intimately connected with growth, possibly oxidative phosphorylation.

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- 28 October 1955

Evidence for a Negative-Feedback Mechanism in the Biosynthesis of Isoleucine

Recent developments in automation have led to the use in industry of machines capable of performing operations that have been compared with certain types of human activity. In the internally regulated machine, as in the living organism, processes are controlled by one or more feedback loops that prevent any one phase of the process from being carried to a catastrophic extreme. The consequence of such feedback control can be observed at all levels of organization in a living animal-for example, proliferation of cells to form a definite

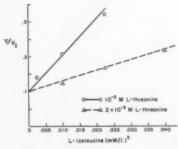


Fig. 1. Competitive inhibition of L-threonine deamination of L-isoleucine. Each point is calculated from an average of duplicate test systems in which keto acid formation from L-threonine was determined. The conditions were the same as those in Table 1 except the substrate and inhibitor concentration.

structure, the maintenance of muscle tone, and such homeostatic mechanisms as temperature regulation and the maintenance of a relatively constant blood sugar level. Because of the complexity of so many biological systems, it is often difficult to postulate a mechanism on the molecular level that would serve in a regulatory function.

Less complex systems for study of internal regulation can be found in the orderly synthesis of protoplasmic components during the growth of bacteria. A simple, though typical, example is the effect of L-isoleucine on the L-threonine requirement of threonineless mutants of Escherichia coli. It has been established that a portion of the L-threonine that is supplied in the medium is converted to L-isoleucine (1). In the presence of the latter, this conversion does not occur, and L-isoleucine itself is preferentially utilized (1) with an accompanying sparing effect on L-threonine (2). Exogenous L-isoleucine might effect its own utilization by (i) reversing the equilibrium along the biosynthetic chain or (ii) by specifically inhibiting any of the several enzymatic steps along that chain. However, because of the irreversibility of L-threonine deamination, which is probably the first step in the conversion of L-threonine to L-isoleucine (3), only an inhibition of this step could account for the sparing effect.

Examination of crude extracts of E. coli strain K-12 has revealed that L-isoleucine is indeed a strong inhibitor of this reaction (4). The data in Table 1 show the degree of specificity of this reaction. It can be seen that L-isoleucine was about 100 times as inhibitory as the structurally similar amino acid, 2-leucine. It has been observed that, of the amino acids tested, only L-isoleucine has a sparing effect on the L-threonine requirement of strain 12B14, a threonineless mutant of E.

Preliminary kinetic studies with Lthreonine dehydrase activity in crude extracts indicate that the inhibition caused by L-isoleucine is competitive. However, in order for the data to fall in straight lines when they are plotted according to the method of Ebersole et al. (5), it is necessary to square the inhibitor concentration (Fig. 1). When the double reciprocal plot of Lineweaver and Burk (6) is employed, it is necessary to square the substrate concentration. This property of the data would be expected if the enzyme combined with 2 molecules of substrate or inhibitor (case II of Lineweaver and Burk). Further experiments are in progress in an effort to decide whether this peculiar kinetic behavior is apparent or real.

It would seem that the interaction between L-isoleucine and L-threonine de-

Table 1. Specificity of inhibition of threonine deamination. In addition to these amino acids at the indicated concentrations, the assay system contained 40 µmoles PO₆ buffer at pH 8.0, 10 μg crystalline pyridoxal phosphate, 10 µmoles L-threonine and E. coli extract with 2 to 3 mg of bacterial protein in a total volume of 1 ml. The reaction mixture was incubated for 20 minutes at 37°C. The extent of deamination was followed by measuring keto acid production by the method of Friedemann and Haugen (7).

Amino acid and concn.	Inhibition (%)
L-Aspartic, 10-2M	30
L-Alanine, 10-2M	0
L-Valine, 10-2M	0
L-Leucine, 10-2M	55
DL-Homoserine, 10-2M	0
L-Methionine, 10-2M	0
L-Isoleucine, 10-2M	100
L-Isoleucine, 10-4M	52

hydrase constitutes a negative-feedback loop that could permit the biosynthesis of isoleucine to proceed only when the level of L-isoleucine in the medium or in the metabolic pool has been reduced to a very low level. The biological consequences of this interaction are being studied further in order to decide whether or not the inhibition of L-threonine deamination by L-isoleucine is in fact an important controlling mechanism in biosynthesis.

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- 21 October 1955

Studies on 4APP: Antineoplastic Action in vitro

In the course of screening experiments for antineoplastic compounds, an isomer of adenine, 4-aminopyrázolo (3,4-d) pyrimidine (4APP) has shown differential cellular damage to several malignant tissues in culture. Antineoplastic activity of this compound has recently been found by Skipper et al. (1) on adenocarcinoma 755 in mice. The present report (2) presents preliminary data from in vitro studies.

The test material included the strain HeLa, a human cervical carcinoma; primary cultures of the B-3 adenocarcinoma of the mouse that had been carried by repeated transplantation in the strain C57 B1/10J; skin and heart tissues of mouse embryos; renal papillae of adult mice; and preputial skin from a human infant.

All cultures were set up in roller tubes. The composition of nutrient media and the procedure of setting up cultures were essentially the same as described by Hsu (3) except that a single cover slip was used for each tube. After the tissues had been established in culture for at least 4 days, the fluid phase was replaced with fresh nutrient that contained various concentrations of 4-aminopyrazolo (3,4-d) pyrimidine. The chemical was incorporated in the medium by simple suspension that was freshly prepared every time. Addition of the agent does not change the pH of the nutrient. The controls received fresh nutrient only. Duplicate or triplicate tubes were used with each concentration for each series. The cultures were then returned to the incubator. After 24 hours of treatment, they were fixed with pure methanol and stained with May-Grunwald-Giemsa. In two experiments, the agent was added to the initial fluid to test possible inhibition of growth.

The stained slides were examined by inspecting more than 1000 nuclei from each type of culture at each concentration. This was done in the same way described by Biesele (4) except that, in the HeLa cultures, the reading was made in the middle area of the outgrowth alone. The proportions of mitotic cells and pyknotic nuclei were selected as criteria for the estimation of cellular damage.

The experimental results are summarized in Table 1 (percentage of mitotic figures) and Table 2 (percentage of pyknotic nuclei). It can be readily seen that this compound produced appreciable damage to the cells of the HeLa strain. Mitotic figures dropped drastically, and practically all the mitotic figures encountered at concentrations of 0.1 mmole or higher were abortive metaphases. On the other hand, pyknotic nuclei increased considerably in the treated cultures, and among the nonpyknotic nuclei many showed other signs of de-generation. The B-3 adenocarcinoma

seemed to be more resistant than the HeLa strain, but the increase of pyknotic nuclei after treatment with high concentrations was evident.

Conversely, all four sets of nonmalignant tissues showed relatively indifferent response to the treatment at all concentrations tested. There was neither a significant drop of mitotic indices nor a great increase of pyknosis. Indeed, the mitotic figures represented all phases and showed no abnormalities.

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- 26 October 1955

Table 1. Percentage of mitosis following treatment with suspension of 4-aminopyrazolo (3,4-d) pyrimidine. Each sample is based on observation of at least 1000 cells. All concentrations are in millimoles,

Tissue	Culture	Time of exposure	*			Co	oncent	ration	*			
	(day)	before fixation (day)	4	2	1	0.5	0.1	0.05	0.01	0.005	0.001	Control
Neoplastic												
HeLa	5	1	0.4	0.8	0.5	0.3						4.0
HeLa	5	1	0.4	0.6	0.1	0.1	0.6					4.0
HeLa	5 5	1			0.4	0.6	1.3	3.1				2.8
HeLa	5	5	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.0	2.6	3.3
B-3	31	1	0.0	0.0	0.0	0.0	0.0					0.1
B-3	5 5	1	0.2	0.0	0.1	0.1	0.0					0.4
B-3	5	5	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.4	0.6
Normal					-							
Mouse embryo skin	5 5	1	0.6	1.4	1.0	2.3	1.7		1.8			1.3
Mouse embryo heart	5	1	1.2	0.7	1.3	1.1	0.8					1.3
Mouse renal papilla	7	1	0.0	0.0	0.0	0.0	0.1					0.0
Human preputial skin	9	1	1.2		0.9	1.2	1.1		1.5			1.0

Table 2. Percentage of pyknotic nuclei following treatment with suspension of 4-aminopyrazolo(3,4-d) pyrimidine. Each sample is based upon observation of at least 1000 cells. All concentrations are in millimoles.

Tissue	Culture	Time of ex- posure	Concentration									
	period (day)	before fixation (day)	4	2	1	0.5	0.1	0.05	0.01	0.005	0.001	Control
Neoplastic												
HeLa	5	1	35.2	19.4	13.8	5.6						1.6
HeLa	5	1	33.7	12.2	7.1	7.4	2.6					0.2
HeLa	5	1				7.9	5.6	4.2	3.6			1.1
HeLa	5	5	100.0	100.0	100.0	87.2	72.9	65.2	34.4	32.1	4.3	1.0
B-3	31	1	11.3	6.5	2.3	3.4	3.3					1.4
B-3	5	1	9.3	3.9	2.4	2.0	1.5					1.1
B-3	5	5	100.0	100.0	100.0	100.0	100.0	91.2	4.4	2.5	0.5	0.7
Normal												
Mouse embryo skin	5	1	1.3	1.2	1.9	0.6	0.4		1.0			0.3
Mouse embryo heart	5	1	0.5	0.3	0.3	0.1	0.1					0.4
Mouse renal papilla	7	1	2.7	1.9	1.6	1.3	2.0					2.4
Human preputial skir	9	1	1.5		1.0	1.5	0.9		0.4			1.5

Crystal Structure of Turnip Yellows Virus Protein

An important problem in the study of purified proteins deals with the role of the salt in the solution from which most crystallize. This can be approached in a new way by the methods we now have (1) for observing with the electron microscope the molecular distribution in some of these crystals. The protein (2) of the turnip yellows virus is a particularly suitable material because it crystallizes readily both from ammonium sulfate and from salt-free alcoholic solu-

In the present experiments, shadowed evaporated-carbon replicas were made from these two types of crystal. Those from salt appear under the optical microscope as moderately well-developed isotropic octahedra. At electron microscopic magnifications, their surfaces are very uneven and are often covered with extraneous material, but it is not hard to see and measure the molecular arrangements on the octahedral (Fig. 1) and the occasional cubic faces that they display. The structure is evidently a cubic close-packing of spheres with a particleto-particle distance of about 360 A and a

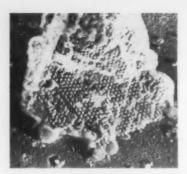


Fig. 1. The octahedral face of a crystal from ammonium sulfate of the turnip yellows virus protein (× 36,100).



Fig. 2. Similar faces to that of Fig. 1 of crystals obtained from alcohol. Note that the magnification is the same for the two photographs (×36,100).

tetramolecular unit cube having an edge length of 510 A.

The crystals precipitated from alcoholacetic acid are prismlike aggregates that show faces with the same hexagonal and less frequent square nets of molecules as those from salt. They appear, therefore, to have the same cubic close-packed structure. Their spacings are, however, very much smaller. This is clear from Fig. 2, which is an electron micrograph of a clump of crystals made at the same magnification as Fig. 1. The interparticle distance here is about 210 A, and the unit cube would have an edge of only

In view of this difference, it might be imagined that the molecules forming the crystals from alcohol are decomposition products of the virus protein molecules. However, this is not the case since solutions of two kinds of the crystals show particles of the same size, and solutions of the alcoholic crystals yield the usual octahedra on the addition of ammonium sulfate. It therefore seems necessary to conclude that the large interparticle distances in the crystals from salt are to be attributed to salt they contain.

It will obviously be of great impor-

tance for studies of the structure of proteins to determine how this salt is distributed. Our experiments directed toward this goal are continuing and will be described in more detail in a paper to be submitted elsewhere for publication.

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References and Notes

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24 October 1955

Cytogenetics of Sex in Gibberella cyanogena (DESM.) SACC.

In view of the recent discrepancies (1, 2) regarding chromosome numbers and sex inheritance in the heterothallic ascomycete Hypomyces solani f. cucurbitae, I have extended my observations to other ascomycetes in the Hypocreaceae, particularly to those that have proved favorable for genetic study. In the present investigation, further information is added to our knowledge of the cytogenetics of sex in these fungi.

Gibberella cyanogena, the perfect stage of Fusarium sambucinum Fuckel f. 6. Wr., is a heterothallic ascomycete that has been found (3) to be hermaphroditic, self-sterile, and interfertile. Perithecia are formed only when the two compatible thalli, A and a, are brought together. Recently, I received through the courtesy of James Tammen of the State Plant Board, Gainesville, Fla., the original thallus, & A, and a mutant of the compatible thallus, & a. Upon examination, the latter appeared to resemble to



Fig. 1. Ascus from Axg a showing two nuclei at second anaphase with 8 chromosomes in each. (× 1800).

a great extent the M-type of H. solani f. cucurbitae (4). It could be distinguished morphologically from the former thallus (C-type) by the lack of color, the absence of perithecial primordia, and the occurrence of relatively more abundant mycelium. When conidia from this mutant were transferred to the other thallus, of A, perithecia with mature asci and ascospores were formed within 2 weeks. Therefore, the new mutant has retained the ability to produce the fertilizing elements; hence, it seems to be homologous to the male strain of H. solani f. cucurbitae and can be designated ô a. When the ascospores from the cross of A× & a were analyzed, the progeny was found to consist of hermaphrodites and males in the ratio of 1/1. Thalli of type ⊈ a were selected from this cross.

Cytological study was then carried out on asci from two subsequent crosses, ⊈ A × 8 a and \$A×\$ a. The aceto-orcein smear technique, which has given good results with H. solani f. cucurbitae (2), was again employed. Preliminary investigations of the nuclear divisions and chromosome behavior inside the ascus have revealed that the haploid chromosome number in each of the hermaphrodites and males is 4 (Fig. 1). Thus, the present data provide clear evidence that mutation of hermaphrodite to male is by no means the result of a single chromosome loss. It is merely a single gene mutation. Finally, it should be noted that these results are not in accordance with the findings of Hirsch et al. (5), who reported the chromosome number in G. roseum to be 6. According to Snyder and Hansen (6), G. cyanogena is a synonym of G. roseum.

A detailed description of these findings is in preparation.

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 W. C. Snyder and H. N. Hansen, Am. J. Botany 32, 657 (1945).
- 31 October 1955

Correction

Harold F. Gray, of Corning, Calif., has called my attention to an error in the note "On the rule for leap year" [Science 123, 544 (30 Mar. 1956)]. In the sixth paragraph of the article (page 545), the end of the second sentence should read "... the century years 1800, 1900, and 2100 are not di-visible by 400 and, hence, are not leap years; but 2000 is divisible by 400 and, hence, is a leap year."
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18 April 1956

Book Reviews

Electro-Sleep. V. A. Giliarovskii, N. M. Liventsev, Yu. E. Segal, Z. A. Kirillova. State Publishing House of Medical Literature, Moscow, U.S.S.R., 1953. 126 pp. Illus. (In Russian)

I. P. Pavlov postulated that sleep represents an irradiation of inhibition. This spread of inhibition is a protective mechanism that is designed to shield the cerebral cortex from excessive stimulation. This inhibitory state or sleep permits the cells of the higher nerve centers to recuperate.

Pavlov, therefore, conceived the idea of the extensive utilization of sleep as a therapeutic measure, particularly in patients with mental disease. In fact, Pavlov considered schizophrenia, with its attendant fixation, confusion, negativism, and so forth, as a form of protective inhibition of the cerebral cortex in the face of excessive traumatizing bombardment with stimuli. The task of the physician, according to Pavlov, is to deepen further this protective inhibition by placing the patients in a calm, restful environment and by utilizing sedative or hypnotic doses of central nervous system depressants-for example, bromides.

Soviet physicians have utilized with apparent success a wide variety of pharmacologic hypnotic agents, including barbiturates, as a means of inducing protective sleep in patients with mental diseases as well as in patients who are suffering from diseases with important psychosomatic components-for example, hypertention and peptic ulcer. Sleep was induced for rather long periods of time: 3 to 4 weeks. The patients were kept asleep for a large portion of each 24-hour period. Naturally, the administration of hypnotics for such long periods produced many undesirable toxic side effects. The result was a search for other means of inducing sleep.

The authors began to investigate the possibilities of using electric currents to produce sleep. Their first experiments dealt with attempts to utilize the methods of electronarcosis that were originally described by S. Leduc [Compt. Rend. Akad. Sci., Paris (1902)]. Electronarcosis is achieved by the application of strong currents that produce a condition which,

according to Leduc, resembles either natural sleep or anesthesia.

After extensive experiments on animals and on themselves, the authors of this book came to the conclusion that electronarcosis does not possess the characteristics of either sleep or anesthesia, but that it is a condition closely resembling, if not identical with, the phenomenon of parabiosis that was described by N. E. Vvedenskii [Survey of Psychiatry, No. 2, 3 (1902) (in Russian); Excitation, Inhibition and Narcosis. Collected Papers, Vol. IV (Leningrad State University, Leningrad, 1935) (in Russian)].

Vvedenskii described parabiosis as a form of nerve block resulting from unusual or strong stimulation. Briefly, Vvedenskii conceived parabiosis as fitting in with the following scheme:

Rest

activity

parabiosis

death.

Parabiosis is thus the last reversible condition resulting from the application of unusual or excessive stimuli. Originally, Vvedenskii observed this phenomenon in nerve-muscle preparations. Later, he applied this concept to the central nervous system.

The authors consider electronarcosis to be a form of parabiosis. The effects on animals and human subjects are more comparable to those induced by electroshock than they are to those induced by anesthesia or natural sleep. They consider electronarcosis to be unsuitable for clinical use for at least two reasons: (i) the occurrence in many cases of "hyperkinetic" reactions, and (ii) unpleasant sensations by the patient lasting for about a day following the application of the current. Moreover, the "narcotic" state lasts only as long as the current is applied, which can be done for only short periods (several minutes).

For these reasons, the authors developed an apparatus that can induce a condition referred to as electrosleep. This is based on I. P. Pavlov's observation that sleep could be induced in dogs by the application of rhythmic electric stimuli of low intensity to the skin of the animals. The authors applied electric stimuli of low intensity and constant polarity at a low frequency (½ second). The dura-

tion of each stimulus was 0.2 to 0.3 milliseconds, a period corresponding to the chronaxie of the brain cells. The electrodes were placed in the temporal-frontal position. Application of these stimuli usually produced drowsiness during the passage of the current and was often followed by a deeper sleep after the stimuli were removed. In some cases, sleep developed after the electric stimuli were discontinued. During this therapy, many of the patients also showed improvement and regularization of sleep during the nights.

The authors cite a number of case histories to indicate the encouraging results obtained with electrosleep in patients with mental diseases (including schizophrenia), neuroses, and asthenic conditions. Successful therapy was also reported in cases with encephalitis and in early stages of toxemias of pregnancy. Investigations are being conducted in applying this form of therapy to patients with hypertension and peptic ulcer.

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Clays and Clay Minerals. Proceedings of the second national conference on Clays and Clay Minerals. University of Missouri, 15–17 Oct. 1953. Ada Swineford and Norman Plummer, Eds. National Academy of Sciences-National Research Council, Washington, 1954. 498 pp. Illus. \$4.

The proceedings of the second national conference on Clays and Clay Minerals contain 36 papers by 64 contributors. These include mineralogists, crystallographers, petrographers, and other geologists as well as physicists, chemists, ceramists, soil scientists, and petroleum and civil engineers, all of whom are actively engaged in research in their respective fields. The book begins with an annotated mileage guide to the diaspore and flint clays and to the Putnam soil of Missouri that were visited on a field trip during the conference, which was held at the University of Missouri in October 1953. Papers are presented on the genesis, occurrence, and diagenesis of clays, methods of identification, fundamental crystallographic and chemical studies, and a variety of subjects including thermodynamics, ion exchange, and the mechanism of the deformation of clay.

The origins of Missouri fire clays, some Pennsylvanian shales of Indiana and Illinois, clays in the northern Gulf of Mexico, and some formations that outcrop on the Gulf Coast are discussed. Several papers are devoted to the clay mineral composition of Recent sediments and soils and its relationship to the diagenetic changes that are taking place in these sediments and to the weathering processes in soils. Illustrations are drawn from the Chesapeake Bay area, from Iowan loess, and from a soil profile on limestone. Variations in the properties of bentonites are connected with the clay minerals present. The occurrence of chlorite and mixed layered minerals and new techniques for identifying the components of complex clay minerals are adequately described.

Not everyone will agree with everything that appears in this collection of voluntary contributions of papers representing the entire field of clay studies, but everyone who reads this volume will find many things of interest and of value. I recommend this book as an important contribution to the literature on clays and clay mineralogy; as such, it is indispensable to anyone who wishes to keep informed of the progress in research on clay materials.

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Biochemical Preparations. vol. 4. W. W. Westerfeld, Ed. Wiley, New York; Chapman and Hall, London, 1955. vii + 108 pp. \$3.75.

This volume continues the presentation of carefully checked and annotated methods for preparation of substances of biochemical interest. This series may profit-ably be consulted not only for complete directions to follow to obtain specific materials, but also for information about the techniques that are employed in these procedures; the techniques are described fully and in an essentially critical way.

The current volume includes chemical methods for the preparation of a number of relatives or possible catabolites of several of the amino acids and sugars: L-histidinol dihydrochloride, carnosine, N-acetyl imidazole, homogentisic and L-argininic acids, DL-methionine sulfoxide and the sulfones of DL-methionine and DL-ethionine, a-D-glucose-1-phosphate, tetraacetyl-p-ribofuranose (tetraacetyl-p-ribopyranose, a by-product), glycolaldehyde, and sodium glyoxylate monohydrate. Urocanic acid is prepared from histidine by the action of histidase, a-D-glucose-1-phosphate from starch by the action of phosphorylase, and p-glutamic acid from the racemic mixture by destroying the enantiomorph with L-glutamic decarboxylase (2 procedures). Preparations of crystalline a-lactalbumin, β-lactoglobulin, alcohol dehydrogenase, and inorganic pyrophosphatase are included. Column chromatography has been used to isolate (dipalmitoleyl)-L-alecithin, and fractional distillation to obtain linoleic acid and methyl linoleate.

A cumulative index for volumes 1 through 4 and a listing of the compounds of biochemical interest that have appeared in *Organic Syntheses* (through volume 34) are included.

RALPH C. CORLEY

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The Marine and Fresh-Water Plankton. Charles C. Davis. Michigan State University Press, East Lansing, 1955. 562 pp. Illus. \$10.

American aquatic biologists have been eagerly awaiting this unique work on plankton, but many of them will experience variously mixed feelings of satisfaction and disappointment when they examine it. It is admittedly pitched toward the level of "graduate students and seniors" in colleges and universities, but in my estimation, and from the student's standpoint, the first 141 pages will probably prove to be the most useful. These well organized chapters comprise discussions of limnetic plankton ecology, adaptations, plankton production, spatial and seasonal distribution, food and feeding, and so forth. Although these pages deal with both marine and fresh-water plankton, the treatment is blended and handled in an efficient manner so that the reader is not likely to confuse or misinterpret the planktonic and ecological factors of the two environments.

For the most part, the material is necessarily general rather than critical, but unfortunately the generalizations are sometimes carried too far. For example, a student who reads the section on the annual cycle of oxygen in lakes will probably gain the impression that the hypolimnion always becomes anaerobic in all lakes during the summer months. Undoubtedly many readers will take exception to the accuracy of certain statements, such as the following selections: "A pond is a shallow lake with rooted submerged vegetation" (p. 3); "Like most salt lakes, the Caspian Sea has many inlets" (p. 7); "The area of . . . Lake Chad may . . . decrease to only 6,000 sq. mi. in the dry season" (p. 8); "Lake Superior with a depth of 1,000 ft. . . . " (p. 8); ". . . lakes vary greatly in their hydrogen and hydroxide ion concentrations (pH)" (p. 10); "The line of demarcation between the two layers [epilimnion and hypolimnion] is known as the thermocline" (p. 13); ". . . stonefly larvae, mayfly larvae . . ." (p. 258); "Book lung -in certain of the Arachnoidea, an external respiratory device" (p. 282).

Pages 142 to 279 include short charac-

terizations of the main taxonomic categories of marine and fresh-water zooplankton and phytoplankton, as well as keys to common genera. Examples of the scope of a few selected keys are as follows: Cyanophyta, 19 genera; Bacillariaceae, 22; Mastigophora, 41; Foraminifera, 8; Coelenterata, 95; Rotifera, 17; Cladocera, 14; and Urochorda, 7.

Pages 281 to 295 contain a glossary of terms used especially in the keys. The literature list (pp. 297-320) is, in general, well chosen and fairly inclusive

through 1952.

Although the discussion material in the first quarter of the book contains some captioned line cuts, most of the figures (49 to 681) are included all together on pages 353 to 539. It is unfortunate that these figures are indicated by number only, all of the captions being completely isolated en masse on pages 321 to 351. Some of the figures are good, others are acceptable, but a surprisingly large number are poor. Few figures are original. A great deal of space has been wasted by inadequate grouping of the figures. Page 354, for example, shows only Coelosphaerium and Microcystis; page 358 has two diatom figures; page 380 shows just two green algae cells; and page 458 contains one needlessly large diagram (unlabeled) of a rotifer.

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Semimicro Qualitative Analysis. Frank J. Welcher and Richard B. Hahn. Van Nostrand, New York-London, 1955. vii + 497 pp. Illus. College, \$6.50; reference, \$8.

Welcher and Hahn have added another textbook to the already voluminous literature of qualitative analysis. The authors have organized their treatment into three main divisions—theoretical, refer-

ence, and experimental.

The principles necessary for an understanding of qualitative analysis are discussed in the theoretical section. A brief description of the structure of the atom is included in order to aid the student in correlating and predicting behavior of the various elements. Whenever possible, the examples cited in this section have been drawn from the experimental procedures. Following each chapter there are a number of questions for the student, together with numerical problems where they are applicable.

The reference section treats each element covered in the experimental scheme by listing oxidation states; coordination numbers; formulas of ions; complex ions formed; and reactions of the element and its compounds with acids, bases, and re-

agents used in the procedures. Balanced equations are given for each reaction.

The experimental section in general follows a conventional hydrogen sulfide system of analysis. However, titanium has been added to the ammonium sulfide group, lithium hydroxide is used to separate the copper and arsenic subgroups, and strontium is separated from calcium with concentrated nitric acid. The procedures are designed for a "'large' semimicro scale" in which 1 to 25 milligrams of a constituent are present in 1 milliliter of solution. Following a brief discussion of the steps involved in the separation and detection of the ions of a group or subgroup, the experimental procedures are then presented compactly in

In general, the book is very well written. The style is quite readable, and the format and organization are excellent. However, I feel that the student might gain more from some of the illustrative problems if they were solved by reasoning from principles rather than by substituting into previously derived equations. The authors' practice of considering the simple ionic species of an element in solution rather than the appropriate complex ion where this species is known is often misleading. The treatment of the hydrolysis of salts of polyprotic acids, such as the bicarbonate ion, serves only as a very poor first approximation. With regard to the experimental section, some of the procedures appear to give very incomplete separations. The authors, however, do not claim that the separations used are the most sensitive or the most rapid, but only that they "give the most reliable results in the hands of beginning students."

The desirability of another textbook of qualitative analysis based on hydrogen sulfide separations may seem questionable, but the lucid theoretical treatment and the extremely complete reference section make this book a worth-while contribution to the field.

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Physics of Fibres. An introductory survey. H. J. Woods. Institute of Physics, London, 1955. 100 pp. Illus. + plates.

Studies of the structures and properties of fibers are becoming increasingly more important with the rapid development of new fibers and the many modifications of the natural fibers to provide the functional and esthetic characteristics that are demanded of modern textiles. Physicists have embarked only in recent years in the research and development work of the textile industry. The demand for this work, however, is constantly growing, and therefore this little book of 100 pages on the physics of fibers is published at a very opportune time.

The six chapters of the book are concerned with general fiber structures; general physical fiber properties; x-ray investigations; optical properties; elastic properties; and electron microscopy of fibers. In each chapter, the author describes the fundamental techniques for the physical measurements and discusses the importance of the results. The eight electron micrographs included in the last chapter are excellent and typical of natural fibers.

The book is not a compilation of photographs and experimental data. In fact, it does not contain a single table of results; however, values pertinent to the discussion are provided in the text. The author condenses a wealth of information in each chapter and guides the reader to specific references in the event further reading and more details are desired.

In addition to the list of 185 references, a bibliography of technical and nontechnical books is given for each chapter. The book is well written and contains an excellent subject index. It is highly recommended to scientists who are engaged in fiber research as well as to those of other fields who may be interested in a general knowledge of the physics of fibers.

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New Books

Techniques Générales du Laboratoire de Physique. vol. 1. J. Surugue. Centre National de la Recherche Scientifique, Paris, 1955. 671 pp. F. 2400.

Life, the Great Adventure. Jean Rostand and Paul Bodin (based on a translation by Alan H. Brodrick). Schribner's, New York, 1955, 1956. 228 pp. \$3.50.

Microbiology. General and applied. William B. Sarles, William C. Frazier, Joe B. Wilson, Stanley G. Knight. Harper, New York, ed. 2, 1956. 491 pp. \$5.75.

The Gardener's Bug Book. Cynthia Westcott. American Garden Guild and Doubleday, New York, 1956. 579 pp. \$7.50.

New Worlds of Modern Science. Leonard Engel, Ed. (reprints from various sources). Dell, New York, 1956. 383 pp. \$0.35.

Current Anthropology. A supplement to Anthropology Today. William L. Thomas, Jr., Ed. University of Chicago Press, Chicago, Ill., 1956. 377 pp. \$5.

Sunken Islands of the Mid-Pacific Mountains. Geological Society of America Memoir 64. Edwin L. Hamilton. Geological Society of America, New York, 1956. 97 pp. Closed-Circuit and Industrial Television. Edward M. Noll. Macmillan, New York, 1956. 230 pp. Paper, \$4.95.

Introduction to Biological Science. A study of the human body and of the world of plants and animals. Clarence W. Young, G. Ledyard Stebbins, Frank G. Brooks (abridgement of The Human Organism and the World of Life). Harper, New York, 1956. 555 pp. \$4.75.

Engineering in History. Richard S. Kirby, Sidney Withington, Arthur B. Darling, Frederick G. Kilgour. McGraw-Hill, New York, 1956. 530 pp. \$8.50.

Miscellaneous Publications

(Inquiry concerning these publications should be addressed, not to Science, but to the publisher or agency sponsoring the publication.)

A Geological Reconnaissance of Panama. Occasional Papers, No. XXIII. Robert A. Terry. California Academy of Sciences, San Francisco, 1956. 91 pp.

A Chemical Study of the Peats of Quebec. P.R. No. 306. J. Risi, C. E. Brunette, H. Girard. Quebec Department of Mines, Quebec, Canada, 1955. 45 pp.

Carnegie Institution of Washington Year Book No. 54. 1 July 1954-30 June 1955, with administrative reports through 9 Dec. 1955. Carnegie Institution, Washington, D.C., 1955. 311 pp. Paper, \$1; cloth, \$1.50.

The Photonuclear Effect and the Complex Potential-Well Nuclear Model. Notas de Física, vol. II, No. 2. J. P. Davidson. Shell Effect on Photonuclear Reactions. Notas de Física, vol. II, No. 4. J. Goldemberg and J. Leite Lopes. 3 pp. + tables and charts. Note on the Non Relativistic Equation for Spin 1/2 and I Particles with Anomalous Magnetic Moment. Notas de Física, vol. II, No. 5. J. J. Giambiagi. 10 pp. Relativistic Theory of Spinning Point Particles. Notas de Física, vol. II, No. 6. J. Tiomno. 20 pp. The Formation of Pos from Atmospheric Argon by Cosmic Rays. Notas de Física, vol. II, No. 7. L. Marquez and Neyla L. Costa. 8 pp. Centro Brasileiro, de Pesquisas Físicas, Rio de Janeiro, Brazil, 1955.

Nuclear Metallurgy. IMD special report No. 2. Symposium arranged by Nuclear Metallurgy Committee. Benjamin Lustman, chairman. American Institute of Mining and Metallurgical Engineers, New York, 1956. 94 pp. \$3.75.

Casting Techniques for Explosives and Other Nonmetallic Materials. Thomas C. Goodwin, Jr. Mauree W. Ayton, Ed. Technical Information Division, Library of Congress, Washington, D.C. (order from Card Division, Library of Congress, Washington 25). 50 pp. \$0.45.

Land Acquisition, 1955. Highway Research Board Bull. 113. 83 pp. \$1.80. Design and Testing of Flexible Pavement. Highway Research Board Bull. 114. 87 pp. \$1.65. Vertical Sand Drains for Stabilization of Embankments. Highway Research Board Bull. 115. 52 pp. \$0.90. Experimental Concrete Pavements. Highway Research Board Bull. 116. 71 pp. \$1.35. National Academy of Sciences-National Research Council, Washington 25, D.C., 1955. 1956.

Scientific Meetings

Protein Symposium

The 17th annual Biology Colloquium at Oregon State College was held 6-7 Apr. on the campus. For the first time the colloquium was extended to 2 days. The subject was proteins in a broad sense. More than 100 persons of the total 250 attending came from out-of-town institutions. In spite of the handicaps of limited time for soliciting speakers and the heavy spring meeting schedules of scientists all over the country, it turned out to be the first protein symposium of this size held in the Pacific West for a long time. Altogether eight speakers gave ten talks. Spirited discussions from the floor and among the speakers made the conference more

Henry Borsook (California Institute of Technology) discussed the role of proteins in biology and his recent work in the biosynthesis of proteins. His work in protein synthesis has been well-recognized and has moved this problem further toward solution.

Heinz Fraenkel-Conrat (University of California, Berkeley) gave speeches on protein reactions and on the reconstitution of viruses. His findings on "hybrid" reconstitution of viruses from the protein of one strain and the nucleic acid from another indicated that the nucleic acid component might determine the heredity of viruses. Although he avoided many newsmen on this subject, he did believe that nonliving and living matter may be on a continuum without a distinct break.

Along the same line, Rollin D. Hotchkiss (Rockefeller Institute for Medical Research) reported his latest work on transforming factors and bacterial genetics. The factors are deoxyribonucleic acids. Even though the nucleic acids that were isolated in his laboratory in the shape of thread fibers may be different from those in situ, they possess transforming activity. The factors are remarkably stable and can be kept in the cold for many months.

Otto K. Behrens presented the work done in the research laboratories of Eli Lilly and Company on the chemistry and biology of glucagon, Glucagon differs in physicochemical, as well as biological, properties from insulin. It contains 29 amino acids, and their complete sequence has also been reported. Choh Hao Li (University of California, Berkeley) discussed ACTH and related pituitary hormones. The interrelationship of growth hormone and ACTH has opened a new avenue in the study of mutual controls in metabolism. Growth hormone is a larger protein molecule than ACTH. The amino acid sequence for α-corticotropin, one of the active forms of ACTH, has been worked out. Its synthesis is being attempted.

Three papers were presented on the physicochemical aspect of proteins. Walter Dandliker reported on the appearance and activity coefficients of protein solutions. Limitations of the classical Svedberg equation were discussed. Application of light-scattering technique with three component systems has now been worked out.

Partition chromatography of proteins and peptides was discussed by Frederick Carpenter (University of California, Berkeley). In spite of the wide use of chromatography for small molecules, its application to proteins has been limited and perhaps will continue to be limited, owing to the nature of proteins. However, certain proteins can be successfully separated and continue to possess regular behavior in regard to pH.

Edmond H. Fischer (University of Washington Medical School, Seattle; formerly from Geneva) presented a talk on the structure of enzyme loci. According to him, as well as Borsook, histidine molecules, owing to pK values, may play an important role in many enzyme systems, such as fumarase.

All papers presented and the discussions will be published by the College Press in September.

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Meeting Notes

■ Some 1500 people are expected to attend the 39th annual conference and exhibition of the Chemical Institute of Canada, which is to be held at the Sheraton-Mt. Royal Hotel in Montreal, 28–30 May. One of the highlights of this conference will be the presentation of the institute's medal to Leo Marion of the Canadian National Research Council in

recognition of his contributions to chemistry. He will speak on "The biogenesis of alkaloids." Louis F. Fieser, professor of chemistry at Harvard University, will deliver the Leroy Egerton Westman memorial lecture on 29 May, when he will speak on the oxidation process developed by the late Samuel C. Hooker.

"The significance of the half-chair conformation in carbohydrate chemistry" is the subject of the Merck lecture to be delivered by R. U. Lemieux, professor of chemistry at the University of Ottawa, on 28 May. Forty manufacturers and distributors will take part in the exhibition of the latest developments in laboratory and chemical process equipment, scientific instruments, chemicals, and technical literature.

- A symposium on bacterial enzymes, sponsored by the department of dairy industry and the laboratory of bacteriology was held on 12 Apr. at Cornell University. Highlights of the symposium were two lectures presented by scientists from France. Anna Maria Torriani of the Pasteur Institute, Paris, discussed the induced biosynthesis of bacterial enzymes, including penicillinase, and Luigi Gorini of the Sorbonne, Paris, spoke on bacterial proteinase and specific conditions necessary for activity.
- The Air Pollution Control Association will hold its annual meeting in Buffalo, N.Y., 20–24 May, at the Hotel Statler. Arnold Arch, air pollution control director for the city of Niagara Falls, N.Y., and John Quinlan, smoke abatement commissioner for the city of Buffalo, are cochairmen of the meeting. Some 700–800 industrialists, educators, administrators, scientists, and municipal authorities are expected to attend, for this is the only international organization whose activities are devoted solely to air pollution control.
- The 1956 Conference on Religion in the Age of Science will take place 28 July-4 Aug. on Star Island, Isles of Shoals, off Portsmouth, N.H. This conference, at which scientists talk with clergymen and theologians, will be devoted to this question: "In the light of the description of the universe and life which the scientists are now giving us, what content can we ascribe to the words good and evil?" Participants, limited to 200, will seek to relate the value codes contained in the biological drives to the value codes of religions and other cultural traditions and to find a frame of interpretation common to both.

The conference members may be roughly classified in three nearly equal divisions: professional workers in religion, professional workers in science, and others. Scholarships for the week's expenses are available to younger theologians and scientists. Persons of any religious background are welcome. For a folder on the conference, write to the registrar, Mrs. Rosalind Holt, Box 156, Pennington, N.J.

A conference on validation of research on pharmacotherapy in mental illness will be held at the Statler Hotel in Washington, D.C., 21-22 Sept. The meeting, which is under the leadership of R. W. Gerard, will be sponsored jointly by the National Academy of Sciences-National Research Council, the National Institute of Mental Health, and the American

Psychiatric Association.

The conference will be based on the presentations of several working groups. Their reports on the methodological, theoretical, and administrative problems involved in evaluating tranquilizing and other drugs, both at preclinical and clinical levels, will be reviewed in committee sessions before the open meeting. Those interested in attending the main conference should write before 1 July to the executive secretary, Dr. Jonathan O. Cole, National Academy of Sciences, 2101 Constitution Ave. NW, Washington 25, D.C.

Scientists from all parts of the world met at the University of Maryland 23-25 Apr. for the first international conference on Ouantum Interaction of the Free Electron. The program, which was held in honor of the 100th anniversary of the birth of Joseph John Thomson, was under the joint sponsorship of the National Science Foundation, the International Union of Pure and Applied Physics, the Office of Naval Research, the Air Research and Development Command, the National Bureau of Standards, and the University of Maryland. Representatives of Canada, Denmark, France, Germany, Great Britain, the Netherlands, India, Italy, Japan, Norway, and the Soviet Union attended the meeting.

On the first evening there was a commemorative banquet. George P. Thomson, British scientist, Nobel prize winner, and son of the man the conference was honoring, gave an address on the history

of the electron.

Society Elections

Federation of American Societies for Experimental Biology, board memebrs: Jules Freund, Public Health Research Institute of the City of New York, chairman; Alan C. Burton of the University of Western Ontario Medical School, pres., American Physiological Society; Herbert E. Carter of the University of Illinois, pres., American Society of Biological Chemists; Harry Beckman of Marquette

University School of Medicine, pres., American Society for Pharmacology and Experimental Therapeutics; Frank W. Hartman of Henry Ford Hospital, pres., American Society for Experimental Pathology; Robert R. Williams of the Research Corporation, acting pres., American Institute of Nutrition; Merrill W. Chase of the Rockefeller Institute for Medical Research, pres., American Association of Immunologists.

- American Institute of Nutrition: pres., Harry J. Deuel; v. pres., Robert R. Williams; treas., John B. Brown; sec., R. W. Engel.
- Scientific Apparatus Makers Association: pres., Henry F. Dever, Minneapolis Honeywell Regulator Company, Philadelphia; pres. pro tempore, R. E. Welch, W. M. Welch Manufacturing Company, Chicago; treas., T. M. Mints, E. H. Sargent and Company, Chicago.

Forthcoming Events

1. Metal Metabolism and Microbiological Deterioration Conf., Washington, D.C. (C. J. Wessel, National Research Council, 2101 Constitution Ave., NW, Washington

1-2. American Psychopathological Assoc., 46th annual, New York, N.Y. (J. Zubin, New York State Psychiatric Inst., 722 W. 168 St., New York, N.Y.

3-6. American Soc. of Refrigerating Engineers, Cincinnati, Ohio. (R. C. Cross, ASRE, 234 Fifth Ave., New York 1.)

3-7. Special Libraries Assoc., annual, Pittsburgh, Pa. (Miss M. E. Lucius, 31 E. 10 St., New York 3.)

4-7. Forest Products Research Soc., Asheville, N.C. (F. J. Rovsek, FPRS, P.O. Box 2010, University Station, Madison 5,

4-8. American Soc. of Civil Engineers, national conf., Knoxville, Tenn. (W. H. Wisely, ASCE, 33 W. 39 St., New York

4-9. International Mechanical Engineering Cong., 6th, Paris, France. (British Engineers Assoc., 32 Victoria St., London, S.W.1, England.)

4-9. International Seed Testing Convention, Paris, France. (C. Stahl, International Seed Testing Assoc., Thorvaldsensvej 57, Copenhagen V, Denmark.)

4-12. Cold Spring Harbor Symposium on Quantitative Biology, 21st, Cold Spring Harbor, N.Y. (M. Demerec, Biological Lab., Cold Spring Harbor.)

6-9. European Federation for Chemical Engineering, 9th, Frankfurt/Main, Germany. (Dechema-Haus, Rheingau-Allee 25, Frankfurt A.M.)

-9. Endocrine Soc., annual, Chicago, Ill. (H. H. Turner, 1200 N. Walker St.,

Oklahoma City, Okla.)

9-10. Soc. for Investigative Dermatology, annual, Chicago, Ill. (H. Beerman, 255 S. 17 St., Philadelphia 3, Pa.)

10-14. Institute of Food Technologists, annual, St. Louis, Mo. (C. S. Lawrence, IFT, 176 W. Adams St., Chicago 3, Ill.) 10-15. American Crystallographic Assoc., French Lick, Ind. (S. Siegel, Chemistry Div., Argonne National Lab., Box 299, Lemont, Ill.)

11-15. American Medical Assoc., annual, Chicago, Ill. (G. F. Lull, AMA, 535

N. Dearborn St., Chicago 10.)

11-15. Symposium on Molecular Structure and Spectroscopy, annual, Columbus, Ohio. (H. H. Nielsen, Dept. of Physics, Ohio State Univ., Columbus.)
11-16. Pacific Div., AAAS, Seattle,

Wash. (R. C. Miller, California Acad. of Sciences, Golden Gate Park, San Fran-

11-23. European Organization for Nuclear Research, Symposium on High Energy Physics, Geneva, Switzerland. (H. Coblans, CERN, Case Postale 25, Genève 15-Aéroport.)

12. National Assoc. of Science Writers, annual, Chicago, Ill. (M. L. Silverman, NASW, 4 Bassett Lane, Atherton, Calif.)

12-14. American Meteorological Soc., Seattle, Wash. (K. C. Spengler, AMS, 3 Joy St., Boston 8, Mass.)

12-15. Max Planck Soc. for Advancement of Sciences, Stuttgart, Germany. (Max Planck Soc., Raiserswerther Str. 164, Düsseldorf 22a, Germany.)

12-16. World Conference on Earthquake Engineering, Berkeley, Calif. (R. W. Clough, Div. of Civil Engineering, Univ. of California, Berkeley 4.)

13-14. Conference for Veterinarians, 25th annual, Columbus, Ohio. (J. W. Helwig, College of Veterinary Medicine, Ohio State Univ., Columbus 10.)

13-16. Colloquium of College Physicists, annual, Iewa City, Iowa. (G. W. Stewart, Dept. of Physics, State Univ. of Iowa, Iowa City.)

13-16. Driftless Area Field Trip, La Crosse, Wis. (R. F. Thorne, State Univ.

of Iowa, Iowa City.)
16-17. Council of American Bioanalysts, Dallas, Tex. (M. F. Dooley, 308 S. Bishop, Dallas, Tex.)

17-20. American Soc. of Agricultural Engineers, 49th annual, Roanoke, Va. (F. B. Lanham, ASAE, St. Joseph, Mich.)

17-22. American Soc. of Medical Technologists, annual, Quebec, Canada. (Miss R. Matthaei, Suite 25, Hermann Professional Bldg., Houston 25, Tex.)

17-22. American Soc. for Testing Materials, annual, Atlantic City, N.J. (R. J. Painter, ASTM, Philadelphia 3, Pa.)

17-23. American Library Assoc. nual, Miami Beach, Fla. (D. H. Clift, 50 E. Huron St., Chicago 11, Ill.)

17-23. International Cong. on Acoustics, 2nd, in conjunction with Acoustical Soc. of America, Cambridge, Mass. (E. H. Kone, American Inst. of Physics, 57 E. 55 St., New York 22.)

17-23. World Confederation for Physical Therapy, 2nd international cong., New York, N.Y. (Miss M. Elson, American Physical Therapy Assoc., 1790 Broadway,

New York 19.)

17-23. World Power Conf. (invitational), 5th plenary, Vienna, Austria. (S. E. Reimel, Engineers Joint Council, 29 W. 39 St., New York 18.)

(See issue of 20 April for comprehensive list)

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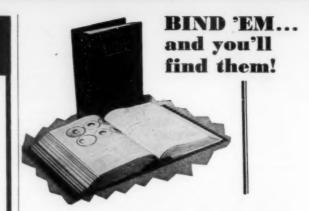
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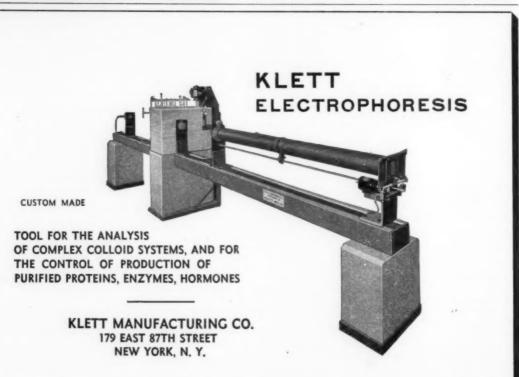
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Equipment News

- ELECTRON DIFFRACTOGRAPH can be used in structural studies for direct observation or photographic recording of electron diffraction patterns of surfaces and thin layers. The instrument utilizes a metal discharge tube with a cold cathode. A beam 10 µ in diameter is accelerated through a variable potential of 20 to 50 ky toward an anode diaphragm in a selfcentering cone, which permits an optical line width of more than 100 µ. Specimen temperature, monitored by a thermocouple, can be increased to 1000° C. The observation chamber has three viewing ports, with a pivotable fluorescent screen. Two electromagnetic lenses of variable focal length make it possible to focus on the fluorescent screen for powder diagrams, on the sample for smallbeam diffraction, and above the sample for shadow microscopy. Magnified images of the sample and of reflections can also be obtained. (Norden-Ketay Corp., Dept. Sci., Snow and Union Sts., Boston, Mass.)
- CATALOG illustrates and describes items for determining moisture quantity in any granular, solid, liquid, or semiliquid material. Listed are moisture tellers, speed ovens, fan-cooled desiccators, and accessory items such as balances, weights, sample pans, and drying dishes. (Harry W. Dietert Co., Dept. Sci., Roselawn Ave., Detroit 4, Mich.)
- WATER CONDITIONER that is designed to prevent formation of scale in boiler, airconditioning, and other heat-transfer systems subjects flowing water to alternating magnetic fields. The unit consists of two sections, a dispersing cell and a homogenizing chamber; it contains no moving parts. Crystallization is retarded, and dissolved salts and minerals become amorphous powders that remain in suspension or settle out as drainable mud. (Pakard Manufacturing Co., Dept. Sci., 2220 W. Beaver St., Jacksonville 9, Fla.)
- ABSORPTION CELL REFERENCE TABLE for use with Beckman spectrophotometers has been compiled by Will Corp. The table provides complete information on 40 absorption cells. In addition, cell compartments and assemblies designed for use with the cells described are illustrated. (Will Corp., Dept. Sci., Rochester 3, N.Y.)
- ELECTROGRAPH, model 420 by Century, provides instantaneous oscillograms. Utilizing electrosensitive paper, with automatic sensitizing and dry developing and fixing, the instrument is capable of 24-trace recording by light beam to 100 cy/sec without amplification. (Century Electronics and Instruments, Inc., Dept. Sci., 1333 N. Utica St., Tulsa, Okla.)

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- Two New Plasticizers have been introduced by Rubber Corporation of America. One of these is a blend of disodecyl phthalate and disodecyl adipate that functions as a low-temperature plasticizer for polyvinyl chloride. It exhibits low volatility and high heat stability. The other product, called DIDP-10, has been formulated for wire coating application and like purposes. It is designed to improve low-temperature brittle points in polyvinyl chloride compounds while maintaining the low volatility that is characteristic of higher phthalate esters. (Rubber Corp. of America, Dept. Sci., Hicksville, N.Y.)
- ANESTHOGRAPH measures the depth of anesthesia of patients who are undergoing surgery. The instrument, which incorporates an electroencephalograph and an electrocardiograph, simultaneously records brain-wave patterns and heartaction tracings. (Edin Co., Inc., Dept. Sci., 207 Main St., Worcester, Mass.)
- LABORATORY FURNITURE is cataloged and illustrated in a new Duralab publication. Specifications are given for center, wall, and titration tables; fume hoods; storage cases; distillation racks; and other equipment. (Duralab Equipment Corp., Dept. Sci., 979 Linwood St., Brooklyn 8, N.Y.)



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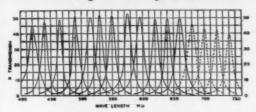
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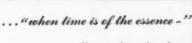
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Symposium at the December 1954 AAAS Berkeley Meeting

Edited by NATHAN S. KLINE

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Unlike earlier drugs that clouded the consciousness of the mental patient or even rendered him unconscious, chloroffine earner drugs that clouded the consciousness of the mental patient of even rendered him unconscious, chiorpromazine and reserpine "have the unusual property of sedating the patient, reducing his overactivity, and allaying his
anxiety, while at the same time he remains fully conscious and thus far more amenable to the various other therapeutic
approaches of a psychological nature. Add to this the facts that the drugs are almost free from untoward side effects,
and that they are non-addictive, and it is easy to see why an extraordinary enthusiasm over their possibilities has been exhibited." (W. Overholser)

This first major conference on the use of chlorpromazine, reserpine, and related drugs covers treatment of schizophrenia, psychoneuroses, manic depression, and chronic alcoholism in children, adolescents, and adults of both sexes. Methods of treatment, side effects, results, and conclusions are presented with case histories and proper cautions about not considering these new drugs panaceas. Discussions of the papers introduce the valuable experience and observations of additional leaders in the field

This volume will be of the utmost importance to psychiatrists, neurologists, clinical psychologists, physiologists, pharmacologists, and biochemists.

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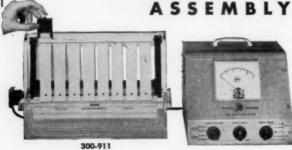


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